ELECTRICAL REVIEW

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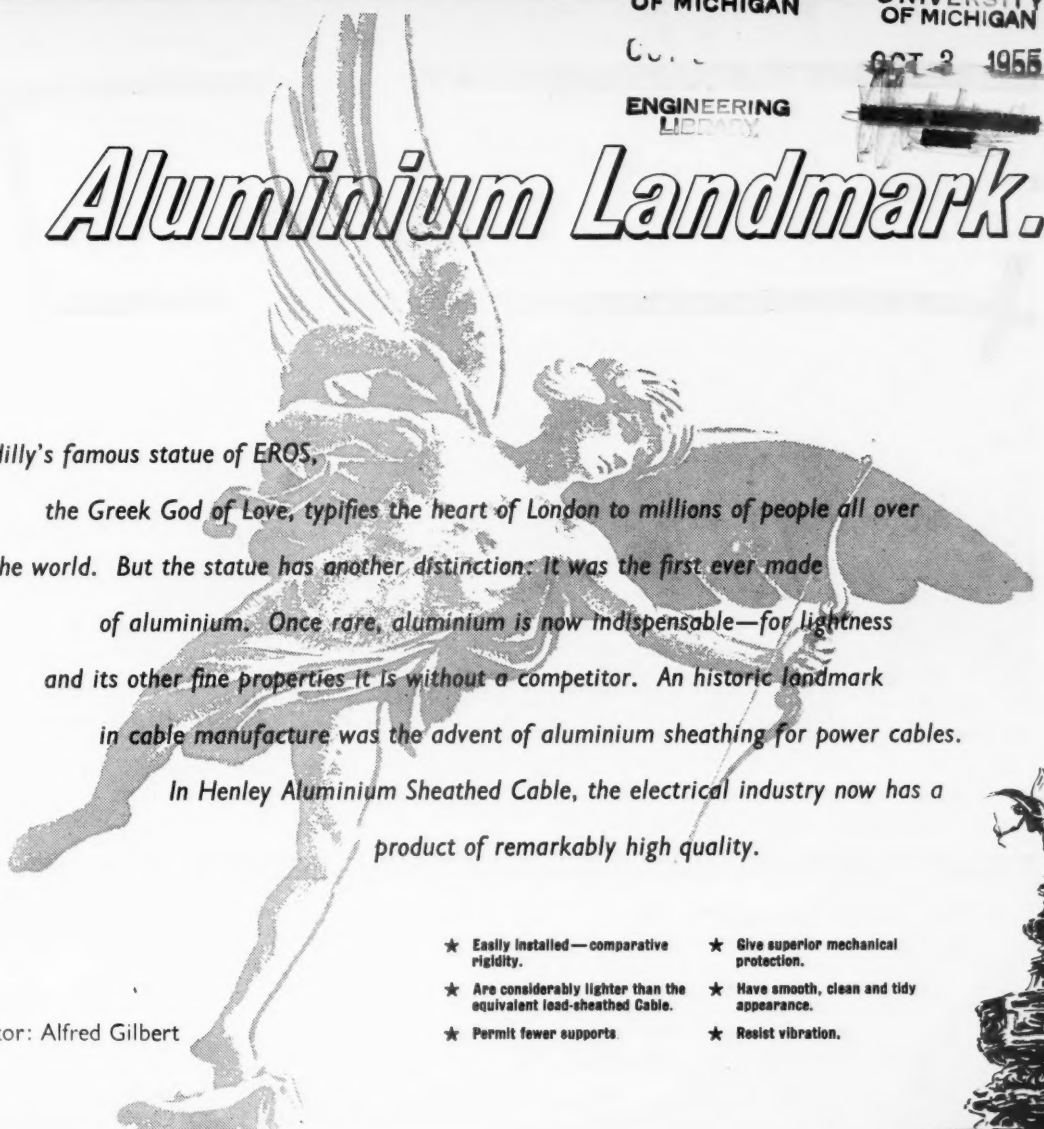

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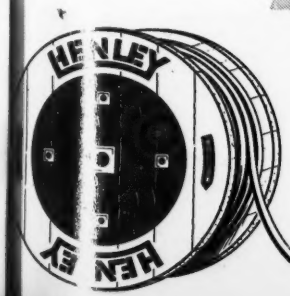

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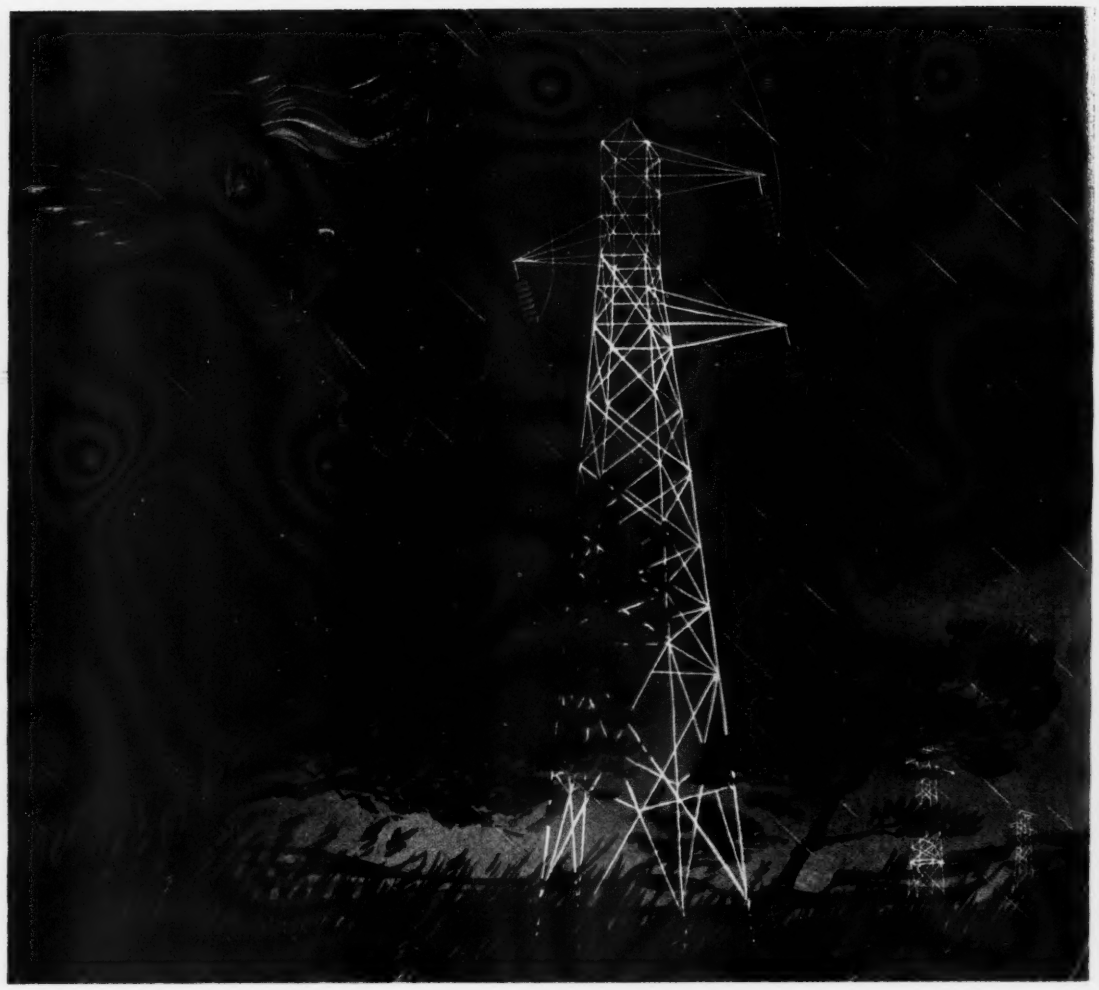

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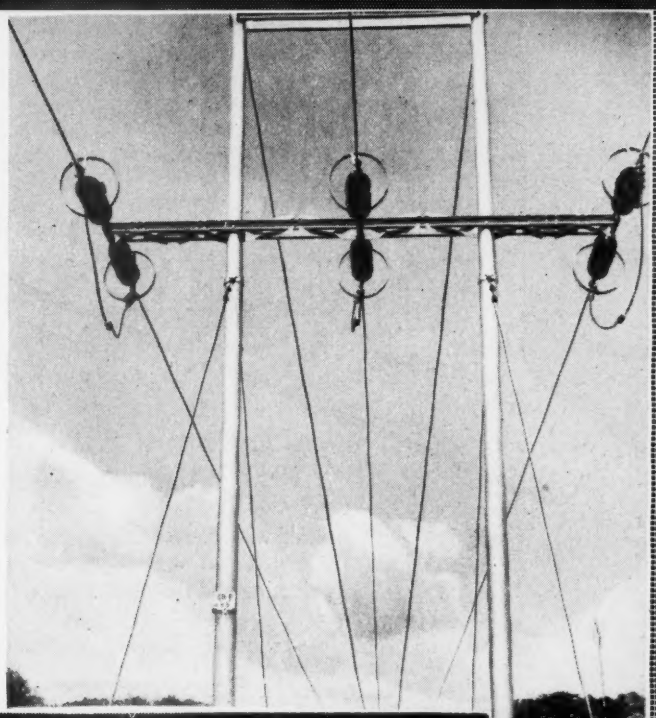

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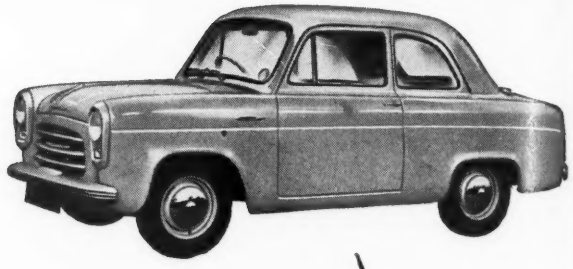

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ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E.
General Editor: J. H. COSENS
Technical Editor: P. W. TUCKER, M.I.E.E.

16 SEPTEMBER 1955

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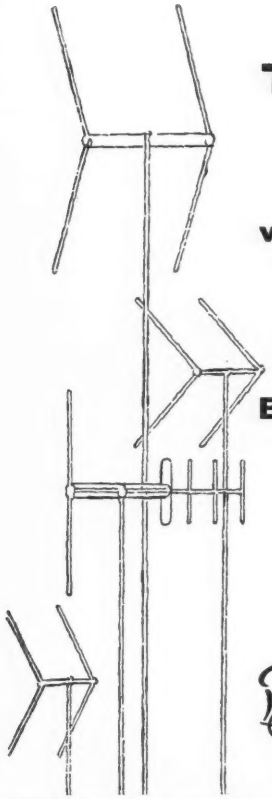

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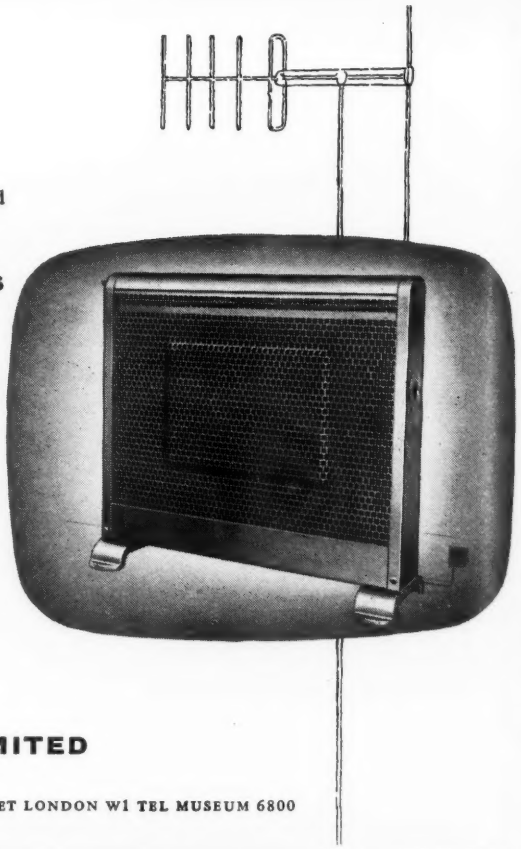

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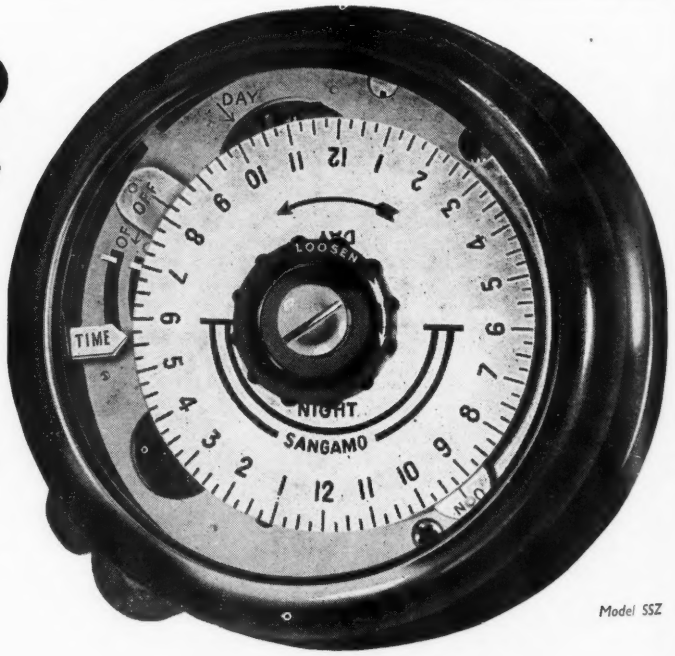

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ELECTRICAL REVIEW

16 September 1955 Vol. 157 No. 12 Established 1872

Unlimited Scope

THERE are few things in modern life which are better value for money than light—which nowadays means electric light. Like the air we breathe it is taken for granted and its great value is not realized until we are deprived of it. But, again like the air we breathe, many people are content with an inferior quality. It is the purpose of this special lighting issue to show readers what is being done in the illuminating art—mainly in industry and street lighting and the wider applications. It should stimulate those in the industry concerned with the installation of lighting and encourage others to ensure that the lighting of their factories and offices is up to modern standards.

It will be seen from the article by Mr. W. J. Jones in this issue that the manufacturers of lamps and lighting fittings are constantly striving to improve their products as well as to educate the public into a better appreciation of the benefits of good lighting. In this connection the Lighting Service Bureaux have done a great deal. One result, as Mr. Jones shows, is the growing use of higher-wattage lamps instead of the smallest possible; the increase in energy consumption is negligible to the individual user.

Public lighting engineers, with the active aid of the manufacturers, are doing their best to solve the problem of making roads which are unsafe enough by day less dangerous at night. Many of the fittings shown in the exhibition at the A.P.L.E. conference at Folkestone illustrate some of the ways in which this is being approached. Lighting authorities all over the country are carrying out lighting improvements, very largely conversions from gas to electricity.

Industrial lighting, a subject with which Mr. R. R. Holmes deals elsewhere in this issue, is another application in which great advances are still being made. Here each installation has to be designed particularly for the class of work engaged in, although there are a few generally-applicable rules. One important subject which has to be attended to is the possibility of drastic rearrangement of machines which necessitates alterations in the lighting. By the use of trunking systems a large measure of " flexibility " is being achieved, avoiding much expense.

Another article, by Mr. J. W. Morse, deals with airport lighting in which many particular considerations have to be taken into account. With the rapid growth of air traffic airport lighting has become a special branch of illumination.

All the developments referred to and innumerable others represent an ever-expanding scope for the lighting industry. The inadequacy of, perhaps, the majority of installations in this country presents great opportunities—apart from export business. This provides another outlet for lamp and fittings manufacturers. Last year exports of lamps, tubes, etc., had a value of about £2,237,000 and those of electric lighting appliances about £4,702,000.

COAL AND THE ATOM

It was the general opinion at the Geneva Conference on the Peaceful Uses of Atomic Energy that electricity derived from nuclear power would be comparable in price with coal-produced electricity within the next decade or so. An uncertain factor was the value of plutonium produced and sold or fed back into the reactors. It was this uncertainty which formed the principal point in the argument against the Government's programme of nuclear power development put forward last week by Sir Robert Robinson, the president of the British Association. Sir Robert said that the contemplated expenditure could not but have effect upon other urgent needs and scouted the idea that our coal resources were in sight of exhaustion. It will not be denied that we still have plenty of coal but much of it is inaccessible except at enormous expense and the supply of miners is diminishing. Nuclear reactors offer a simpler method of obtaining power and in the long run a cheaper one, for design and operating experience will inevitably, as always, lead to great improvements in efficiency and lower cost.

PUBLIC LIGHTING PAPERS

We have been much impressed by the high standard of the papers which have been presented this week at the annual conference of the Association of Public Lighting Engineers at Folkestone. They dispel suggestions that have been made that as a result of the nationalization of the electricity supply industry a new class of public lighting engineers, essentially local authority officials, has taken the place of the former public supply engineers, who were generally officials of electricity supply undertakings, with the result of a lowering of standards electrically throughout. Messrs Berry and Shaw, in their paper "Local Authorities and Public Lighting"; Mr. Walsh, in his paper "The Code of Practice for the Lighting of Roads other than Traffic Routes"; Messrs. Ferguson and Stevens, in their paper "The Lighting of Tree-Lined Roads"; and Mr. Mackenzie, in his paper "The Centralized Control of Street Lighting," all emphasize the electrical side. If we may include the presidential address among the papers we would stress the realistic note given by Mr. Waldram. He says that "bad lighting may make a good road dangerous or slow, but good lighting cannot make a bad road good." We certainly agree, so long as it is fully appreciated that good lighting is required in all cases.

TRAFFIC DENSITY

Electrification of the railways in Belgium at 3,000 V d.c. is more economical than it would have been at either 1,500 d.c. or 25,000 V a.c. single-phase, Mr. J. Snoeck (Belgian Association of Electric Power Enterprises) has stated in a letter to *The Times*. Stationary d.c. substations are spaced at 28 to 31 miles apart with 3,000 V, compared with 6 to 10 miles with 1,500 V. The latter voltage, however, is standard for conditions in Great Britain, where the higher overall cost of 3,000 V motors and other apparatus is a determining factor. Where, as in the north-east of France, the a.c. substations are on the locomotives, their number is directly related to traffic density, upon which a comparison of the systems mainly depends. With modern developments the traffic density at which a.c. compares favourably with d.c. has been raised considerably. A French criterion, reported by us on 19th August, gives a coal consumption of 644 tons/mile/year as marking the point at which d.c. becomes uneconomic under conditions there.

EFFECTS OF AUTOMATION

In the view of Mr. John Diebold, a prominent American authority, as expressed in *The Manager*, automation holds no threat to our economy. He says:—

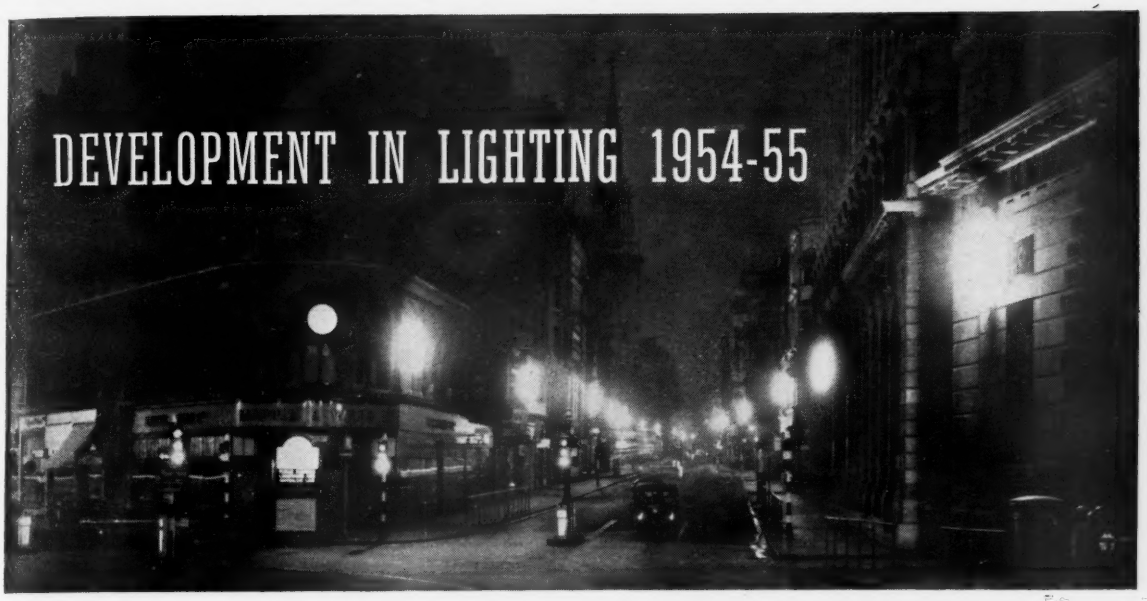
> "The worst mistake that can be made in assessing how automatic control will affect labour is to make use of 'obituary accounting'—to add up the number of men replaced by a machine, multiply that by the number of machines and call the result 'unemployment' . . . assuming that only a set number of jobs exist in our economy."

He thinks that the impact of automation will be not so much to use fewer men as to use men for fewer hours at better work. Speakers at last week's Trades Union Congress on a resolution (which was carried) recognizing both the opportunities and problems associated with automation were at variance but it was the opinion of the T.U.C. General Council that it would be possible for displaced men to find their way into other occupations if automation was not introduced too rapidly. That, we think, is the main consideration. At present labour is not too mobile, for very good reasons, and it is time that thought was given to the subject. The problems will not be solved by nationalizing "automated" industries, as some of the T.U.C. speakers suggested.

ELECTRICAL ACCIDENTS

Analyses of the accidents arising out of a wide variety of electrical causes which come to the notice of the Factory Department year by year reveal trends that exhibit reasonably close statistical relationships. The conclusions to be drawn from these, as set out in the Department's annual report on "Electrical Accidents," of which that for 1953 is reviewed on a later page, are likely to help considerably in getting to the root of trouble. One particular value is the division and subdivision of accidents associated with portable apparatus and their connections which account for nearly half the total number. Another feature of outstanding importance is the inadequacy of many earthing systems which appears in about one-third of the cases. While the total number of electrical accidents has tended to fall since the end of the war, the proportion of fatalities has somewhat increased.

Electric fires will be the subject of the next in our series of illustrated surveys of domestic electrical equipment (23rd September issue). Particulars, given in tabulated form, will include details of type, loading, elements, finish, price and purchase tax



Ever-Higher Illumination Levels Demanded

By W. J. JONES, M.Sc., M.I.E.E.*

WITHOUT any doubt the outstanding feature of lighting development during the last twelve months has been the all-round increase in tempo. More users are demanding more light so that the industry as a whole has been called upon to supply more lamps, fittings and associated apparatus than ever before. This rate of expansion, which compares favourably with that of any other country, shows no sign of slackening, but there is plenty of room for further progress; in the sale of lamps per head the United States is still some way ahead of us.

The higher levels of illumination in popular use have been achieved partly by the use of higher wattage lamps. It is significant that the latest revision of B.S. 161 makes no mention of the 15 W lamp, which can now almost be ignored for ordinary lighting purposes. This year, for the first time, the sale of 100 W lamps has exceeded that of any other size, and is now nearly one-third of the total. About one-tenth of all tungsten lamps sold are now of the 150 W size; that is more than the sales of 15 W and 25 W lamps put together, and represents a three-fold percentage increase in the last twenty years. By contrast, the 40 W lamp, which is perhaps the smallest capable of doing a useful lighting job on its own, is now relatively half as popular as just before the war.

Lighting and the National Economy

The year has also seen an accelerated movement by the Electricity Boards to change their systems to the national standard 240 V supply, and it is understood that plans exist for a further move in this direction next year. This activity, though involving a change of only 10 V in many cases, is of more concern to the lighting section of the industry than any other for a difference of 10 V greatly affects the performance of tungsten filament lamps although it makes no significant difference to much heating and power apparatus. This voltage standardization, though temporarily upsetting to individuals, must be to the eventual benefit of all, and not least to wholesale lamp suppliers whose storage problems will be greatly simplified.

Even to-day it is not often realized how closely the national economy is bound up with the supply of electric lamps and the kind of light they provide, which has such a marked influence on the quantity and quality of production in industry, the sales of commercial enterprises, and the well-being and contentment of people in every kind of occupation or recreation.

The motor car industry in general appreciates the value of good lighting and uses it. Moreover, in terms of value, the motor industry is the largest exporter in the country, and practically every one of the near half-million private and commercial vehicles exported in the last twelve months have been equipped with sixteen or more lamps. Recent reports indicate that this industry is being geared to even greater efforts next year, to which E.L.M.A.'s contribution will be some eight million " car-borne " lamps.

Public Lighting

Much public attention has been focused on the state of our roads. The present Government has already loosened the purse-strings very slightly, but the construction of new roads or the rebuilding of old ones capable of handling present and probable future traffic requires vast capital expenditure which some Government must ultimately sanction. These present and future roads cannot serve their full purpose if equipped with lighting of the past which makes it difficult for the driver to see, whether or not he uses his headlights.

Energetic steps are being taken to improve the lighting of trunk (Group " A ") roads and almost every day notice is given of a change-over from gas to electric lighting. This conversion is much overdue, bearing in mind that even to-day over one-third of all street lamps are still lighted by gas. At the present rate of progress it may take nearly 20 years to complete the conversion, but it

* Director, Electric Lamp Manufacturers' Association of Great Britain.

Above: Poultry and Cheapside, City of London, newly lighted by vertical fluorescent lanterns mounted on the face of buildings

has been shown elsewhere† that in, say, five years the work could be done where practicable at an expenditure of only £18 million, and the public concerned would receive 200-300 per cent improvement over their present lighting.

In the street-lighting field the general improvement of mercury and discharge lamps, particularly in respect of their increased lives, has reduced lamp and maintenance costs on traffic routes where colour is not of primary importance. Where colour is important, as in city centres, there has been a considerable increase in tubular fluorescent lighting, and this has spread to outlying areas as well. In Northampton, for instance, the conversion of all the main streets to fluorescent lighting is more than half completed. In the City of London more streets have been lit by vertical fluorescent lanterns mounted on the faces of buildings, a method of lighting particularly suited to the narrow streets concerned. In residential roads (Group " B ") in Crawley and elsewhere much of the street lighting is by twin 2ft fluorescent lamps.

Since the A.P.L.E. Conference in 1954 the 400 W mercury lamp with the fluorescent bulb incorporating a new phosphor has been available, combining high efficiency with very good colour correction, and consideration is now being given to the production of a 250 W lamp of the same type which will be interchangeable with the ordinary 250 W mercury lamp, but with a 7 per cent red content of light and no relative loss of efficiency.

Street-lighting engineers in particular will be interested in recent research aimed at the production of one-piece sodium lamps having no separate vacuum jacket. Much progress has been made already, and experiments so far indicate the possibility of improved lumen maintenance throughout life, the probability of reduced capital costs of new installations, and simplification of difficulties now encountered in handling and storing the separate parts.

There is no shortage of lamps, fittings and ancillary gear, but there is still a bottleneck in lighting development —the mechanical difficulty of taking down and replacing antiquated or inadequate fittings by better ones, or shifting the position of fittings, or adding new ones to suit a new layout of plant, furniture or people. To a very large extent trunking solves the problem in industrial and some commercial interiors, and it is indeed gratifying to note the remarkable success the various systems are having, but trunking is hardly applicable to many public buildings and not at all to homes where there is enormous potential lighting business to be done.

The author has already on many occasions expressed the opinion, and is still convinced, that the lack of socket-outlets is by far the fiercest brake on domestic lighting development, and that no spectacular results can be looked for in this field until by some means or other it becomes possible for the ordinary householder to put a lamp where he wants it, without the floor or ceiling being festooned with flex ending in multiple adaptors. Where they are installed ring mains simplify the problem very considerably, but there are millions of homes and only a few ring mains.

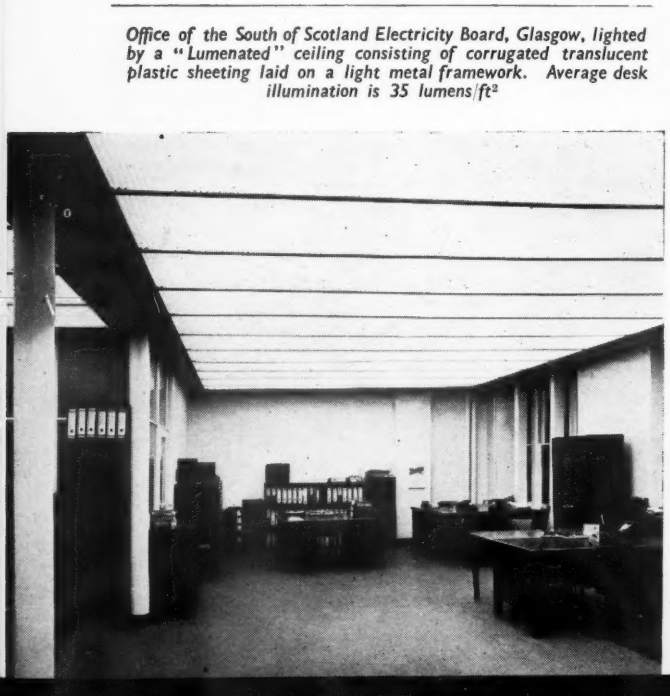
Illuminated ceilings, which are excellent for many commercial interiors, are not of recent origin, but the structural work necessary has been much simplified by the availability of extremely light corrugated translucent vinyl sheeting which is arranged to lie on a thin metal framework and thoroughly diffuses the light of fluorescent or filament lamps on the real ceiling above. From the author's experience in the United States, however, it seems that even when the room is illuminated to a high degree there is always the risk of a monotonous effect from an almost perfectly diffusing ceiling unless " accent " lighting of some kind is added to provide lustre and visual interest.

Demonstration section of " Invertrunking " being used to support a fitting and acoustic ceiling panels at one side. The trunking carries the wiring which is fitted with connectors at suitable intervals to allow fittings to be moved or others inserted. The bottom of unoccupied lengths can be closed by spring fillets

Space does not permit more than passing mention of the " Module " ceiling fittings among the various new types introduced during the past year. Broadly, this has been a year of consolidation rather than one of spectacular advance, as must occur every now and then in a healthy industry. It implies no slackening of effort on the part of those engaged in lighting, or loss of interest by those to whom lighting is sold. Some of the latter have even encouraged the former to bolder thought, for the upgrading of many of the recommended levels of illumination in the newly revised I.E.S. Code is at least partly due to the fact that progressive businesses have installed lighting giving higher—sometimes considerably higher—illumination than that recommended in the old Code. After the weary years that have been spent in trying to persuade users not to cut lighting to the barest minimum, this is indeed an encouraging sign.

† B.E.P.C., 1954. " Lighting for Commerce, Industry and the Home," W. J. Jones.

Office of the South of Scotland Electricity Board, Glasgow, lighted by a " Lumenated " ceiling consisting of corrugated translucent plastic sheeting laid on a light metal framework. Average desk illumination is 35 lumens/ft²



Industrial Lighting

Some Modern Trends

By R. R. HOLMES, M.Sc.*

THE last ten years have seen spectacular developments in production methods and also in the accompanying lighting. Not only are the values of illumination installed fully up to, or above, those recommended in the I.E.S. Code, but the way in which lighting is laid out and erected has undergone considerable change. In this short review only three outstanding features will be discussed—continuous trunking, roof structures without the familiar framed trusses, and fitting ranges with standardized, interchangeable, parts.

Apart from providing adequate illumination the modern lighting system must possess flexibility and yet involve low installation, maintenance and running costs. At no time has the importance of flexibility been greater; new industries expand at a surprising rate and the building that is doing duty as a store this year may well contain a production line in twelve or eighteen months' time. Dismantling a lighting installation because it cannot be adapted to meet a new requirement is liable to be a costly business, and with this in mind the continuous trunking systems, on account of their ease of adaptation, go far to meet the demand for lighting flexibility.

A well-designed continuous trunking system allows the lighting units to be disposed at any required intervals along the length of the run, regardless of positions of supports or of joints in the main trunking member. The trunking should be rigid, with firm joints, should have provision for electrical continuity for earthing and, with advantage, may have facilities for carrying other service runs if required. A particularly useful feature in some designs is free access to the wiring channel from below, so that wiring can be lifted into place after the trunking has been installed, without " drawing-in."

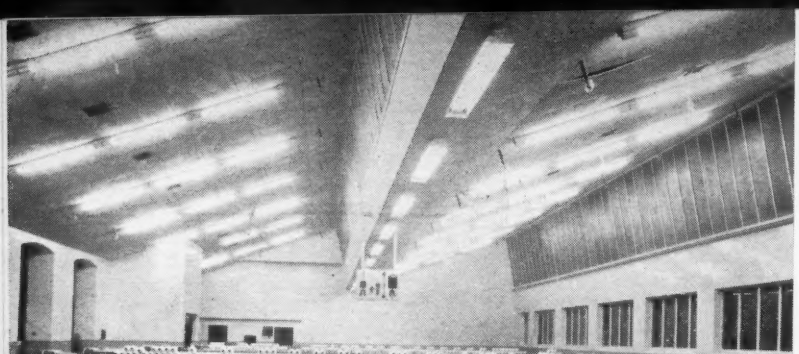
Such a system enables skilled connecting work to be done at ground level with a consequent speeding-up of the job and saving in costs. Attention should be paid when selecting trunking to the method of joining the sections: the requirements are that the joint shall be absolutely rigid, strong and firm, and be made with only simple tools—preferably without drilling the channel members at all.

Detachable lighting units, with a plug and socket for ease of removal, are to be found in a good design and the methods of securing the control gear tray, reflector and any other components should be simple, safe, and able to be carried out single-handed if possible without special tools. The choice of a design incorporating such features ensures minimum time during maintenance in replacing any faulty component or in making alterations to an existing installation.

The long intervals possible between supports—usually some 12ft to 15ft—result in a neat installation with the

* Crompton Parkinson, Ltd.

1.—Modern continuous mounting installation in the design office of Saunders-Roe, Ltd., Queen Square, London, W.C.1. 2.—Lighting trunking below deep beams at Venner, Ltd., New Malden, Surrey. 3.—Automatic machine shop with continuous trunking system for lighting: Belling & Lee, Ltd., Enfield



Direct mounting across north-light roof: drawing and roving, E. Clegg & Son, Ltd., Littleborough. (Even lighting but rather a large area of source exposed to view)

minimum number of down-rods or chains. This is a point of some importance in modern structures where a multiplicity of suspensions would be out of keeping with the building design.

Of all the features one which should warm the heart of any practical electrician is the possibility of avoiding roof-level wiring and long down-drops by feeding into the trunking from the walls at the ends of the runs. This not only saves material and reduces installation costs, but effects a permanent simplification for maintenance and fault tracing as the cables are accessible at fittings and not at roof-levels as in most conventional conduit installations.

With a trunking system it is possible to anticipate future requirements in the initial installation. The substitution of two-lamp for single-lamp fitting units is an obvious way to increase the illumination, but where the initial spacing of units allows of others to be inserted in between, it is sometimes possible to make additions without disturbing the original units or wiring. Where the original cable size and switching arrangements are adequate the sockets for the new fittings can be " looped-in " to the nearest sockets on the original system.

In this connection arrangements in which the trunking is supported across, but below, the booms of " A " frame roof trusses enable the lateral spacing between rows to be changed without difficulty, should it be required. The alternative, with the runs passing through the openings in the frames, is less flexible but is dictated sometimes by the clearance height necessitated by the sweep of a travelling crane. Passing the trunking through the truss openings also prevents the cabling from being connected at ground level and being directly lifted into place from below even with systems possessing that feature as part of their construction.

Some of the changes in wiring and installation have arisen to match new building techniques. Many modern buildings, particularly of the " north-light " variety, are being designed without framed trusses carrying the roof span. These " shell " type roofs, as some are called, offer novel problems for the lighting engineer: not only has he few obvious supports for his runs but access to any high-mounted fittings in the middle of the structure may be difficult owing to absence of a ladder support. Mobile maintenance towers are a possible solution but their movement is restricted if there is much permanent or bulky machinery.

Apart from such practical points as these the architect who has successfully obtained an effect of uninterrupted space is unlikely to favour much, if any, " electrical ironmongery " dangling in mid-air.

Two lines of development appear to be commonly adopted in arranging lighting for buildings with this type of roof construction—direct attachment of fittings to the structure, and the use of a restricted number (one or two, as a rule) of trunking runs down the bay and possibly one under the valley gutter. Mounting on the structure is neat in appearance but it is difficult to find positions which at one and the same time give even illumination, little glare, and yet are readily accessible for maintenance.

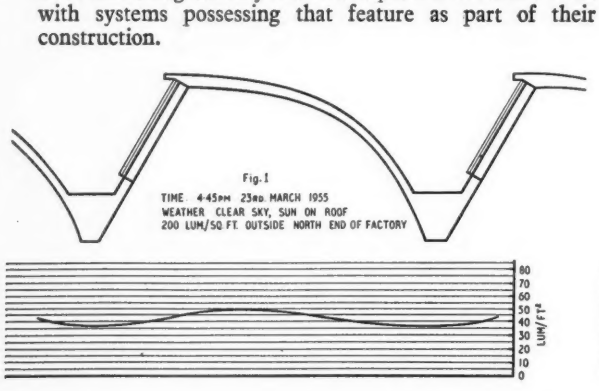
Bally's Shoe Factories (Norwich), Ltd., to whom the author is indebted for the information for the diagrams Figs. 1 to 4, have shown commendable enterprise in undertaking their own comparative tests employing different arrangements of fluorescent tube fittings. The artificial illumination values are those for a brand new installation and lower values would be obtained as the average throughout useful life.

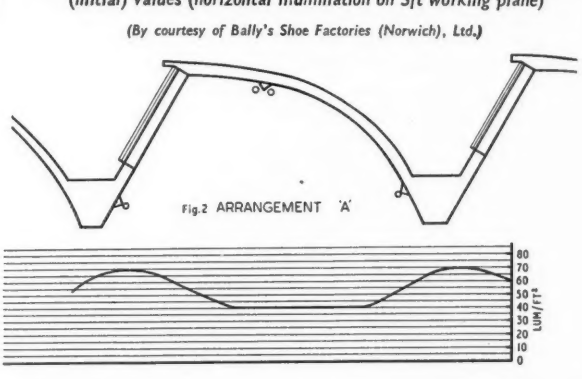
The excellent uniformity of the daylight chart (Fig. 1) emphasizes the successful function of the roof design. Fig. 2 shows an arrangement " A " which would appear to be the most acceptable from the purely lighting point of view as the powerful twin-tube unit is well up out of the field of view. The two single units may give some glare while access to the central units may be difficult.

Arrangement " B " in Fig. 3 gives higher illumination but somewhat greater risk of glare than " A " and retains the somewhat inaccessible central units. In " C " we have an arrangement still giving reasonable illumination from fittings at an accessible level but with more risk of glare. A very similar arrangement to " C " has come to the writer's notice recently illustrating certain machine shop lighting on the Continent.

North-light roof lighting systems: daylight and artificial illumination (initial) values (horizontal illumination on 3ft working plane)

(By courtesy of Bally's Shoe Factories (Norwich), Ltd.)





Horizontal illumination value must not be taken as the only criterion of such installations. A well-lighted background behind each fitting is essential if glare is to be minimized and the impingement of direct and reflected light on to the working planes must be studied in relation to the local obstructions likely to be encountered.

Experience to date indicates that these rather unusual lighting systems give less trouble from undesirable shadow and glare than the lighting engineer would naturally expect. It is very possible that the concentration of the worker on his task makes him less conscious than the engineer of the brightnesses in the visitor's field of view; but where much movement and horizontal viewing takes place these brightnesses may prove to be of importance. Lighting engineers will perhaps do well to study the operators' reactions to these systems of lighting when they have been in operation long enough for all parties to gain more experience.

The direction of lighting from systems such as arrangement " C " will not necessarily correspond to the directions obtained in natural daylight, and how far shadows, and the variety of illumination on vertical planes from one point to another, will affect the task only local experience can decide.

Bare Tubes *v.* Reflectors

Although experienced lighting engineers usually recommend reflector type fittings for industrial installations (in order to get the best concentration of light at the working point with adequate freedom from glare), several extensive bare-lamp installations have recently been installed.

Reports from some managements are that they are completely satisfied with the results of such a system and that the workers do not complain of glare. The writer would prefer to wait for longer experience before accepting such an opinion as final, for all the recent research work in this country and elsewhere on brightnesses in the field of view would lead one to think otherwise. One thing in connection with most of these installations is that the building is newly decorated and the lamps are, at present, seen against a very light background. In time, this may no longer be the case, and it may eventually prove desirable to fit reflectors to the fittings rather than have to clean the whole ceiling surface frequently to bring the brightness relationships back to those experienced when the lighting was installed.

Where reflectors are fitted those allowing some upward light are adopted for most installations as there is usually no loss in total efficiency and the lighted ceiling or roof avoids the depressing " tunnel " effect experienced when all the lighting is directed downwards.

Basic channel and lamp unit in light surroundings: weaving shed, Brindles, Ltd., Chorley. (The unit allows the addition of end-plates and reflectors at a later date, if required)

The latest practical development in lighting equipment is the introduction of basic components to which may be added various interchangeable parts to form a series of related lighting fittings. In this way it is possible to incorporate in the base constant fixing arrangements, wiring and control gear, and with the variables of reflectors or diffusers to provide the light control or appearance called for by circumstances.

The advantages of such a system are readily apparent: not only is the erection of fittings simplified by many types being built up on the same base, but stocks of spares are reduced in number as so many parts are interchangeable. In a particular design the side wing reflectors are independently removable so that an asymmetric distribution can be obtained if required, while the individual reflectors can be cleaned without removing the lamp. The separate reflector wings will " nest " in the store and occupy far less space than complete reflectors of the normal one-piece pattern.

The possibility of changing the reflector material from, say, metal to a translucent plastic extends the application of the fitting with the minimum change of components. In one of the most advanced range of designs " commercial " style enclosing diffusers can also be added to the standard basic channel portion, so that there is no re-wiring or dismantling to be done if, say, an office area is required at short notice to be used as a visitors' reception space.

Modern lighting equipment requires examination in detail if the advantages of good design are to be checked and appreciated: time spent in this way is rewarding by reason of the economies that the best designs can produce, as well as because of the wide range of facilities which they can afford.

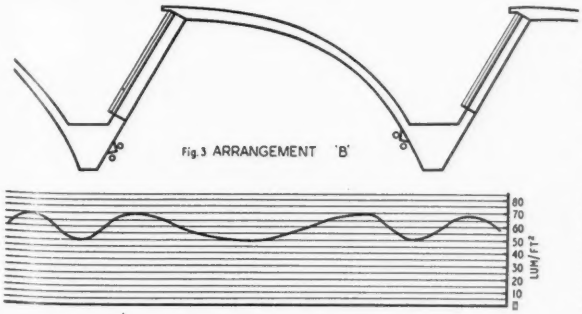


Fig. 3 ARRANGEMENT 'B'

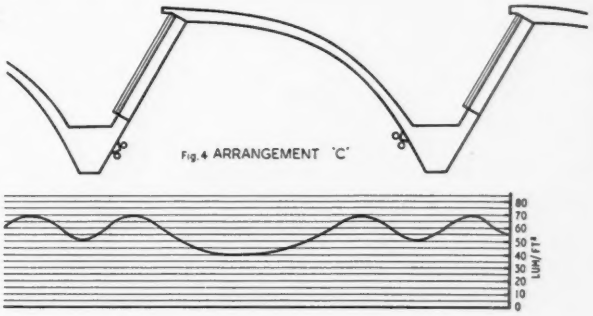


Fig. 4 ARRANGEMENT 'C'

Airport Lighting

Its Vital Part in Modern Aviation

By J. W. MORSE*

"TRANS-EUROPA AIRWAYS announce the arrival of their flight XY.127 from Athens, and passengers will be coming through Channel II in approximately 15 minutes." This announcement, preceded by a similar one three minutes earlier and to be followed by another three minutes hence, is an indication of the regularity with which airliners land at a large airport in fair weather or foul. It is, perhaps, obvious that a great and complex system of control is at work behind the scenes, both on the ground and in the air, culminating in these simple broadcast messages. This survey is intended to explain briefly that part of the system in which the illuminating engineer is concerned.

Aircraft are navigated towards and approach the immediate vicinity of the aerodrome by means of various instrument and radio aids before making a final visual landing. At night virtually all the visual indications required by the pilot in landing have to be provided by lighting, but in daylight the actual ground features provide much of the information, although during all but the clearest of visibility conditions these features have to be supplemented by ground markings and lighting. It may not be generally realized that a greater level of lighting is required during reduced visibility by day than in similar atmospheric conditions by night.

The basic principle of aerodrome lighting is to present to the approaching pilot a lighting pattern which he can see and recognize easily, and will enable him to make a quick and accurate interpretation of the information given. He wants to know exactly the limits of the runway on which he is to land and also other information which will help him approach it in a correct "attitude" and make his actual touchdown within a preferred area on the runway. Simplicity of the lighting pattern is of great importance since, particularly in poor visibility, the time taken for the pilot to change over from "instrument" flying to a fully controlled "visual" approach is short and when "visual" the information presented to him must be in such a form that he employs the same mental processes for guidance as those to which he is accustomed in clear daylight.

So far as the runway is concerned, all that is necessary is that the paved area should be outlined with sufficient lights to give a clear indication of its physical limits. In practice this means that lights are mounted along the longitudinal edges of the runway at a spacing which depends on the visibility conditions being catered for: these will also dictate the best form of light distribution. In conditions of poor visibility, aircraft approach a runway on a straight course, forming an extension of the runway centre line, by one or more of the standardized radio or instrument aids, and the pilot can only expect to become "visual" when his aircraft comes through what has been called the "approach portal" some ½-2 miles away from the beginning of the runway. In these conditions each runway light must provide a high-intensity beam directed towards the approach portal if it is to be visible to the pilot of the landing aircraft. Any light not so directed is not only wasted but is in fact liable to reduce the effectiveness of the system by illuminating the surrounding atmosphere and so reducing the visual contrast between the lighting and its background.

* Exterior Lighting Dept., General Electric Co., Ltd.

Title illustration: High-intensity approach and runway lighting, Jan Smuts Airport, Johannesburg. (By courtesy South African Railways)

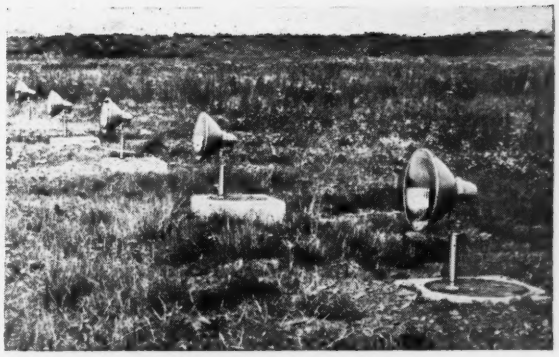
Runway lights having this form of distribution are called "high intensity," and if arranged for landing in one direction only, "high intensity uni-directional." Where both directions of landing are catered for the lights are arranged to provide two beams separated by approximately 180 deg and are then termed "high-intensity bi-directional." At aerodromes where the visibility conditions do not necessitate high-intensity runway lighting, a low-intensity type is used in which the light is not confined to the directions parallel to the runway axis.

Approach Lighting

Whilst runway lighting, together with similar lighting across the ends of the paved area (known as threshold lighting) is sufficient to define the limits of the landing area, it does not necessarily give the pilot all the guidance information he requires to complete his approach and ultimate touchdown. This is provided by additional "approach" lighting, commencing anything from 3,000ft from the runway and continuing up to the threshold. Again a simple pattern is required and it generally takes the form of a row of lights forming the extended centre line of the runway, together with one or more transverse lines of lights known as "horizon bars" or "crossbars."

This approach lighting pattern gives the necessary directional, lateral and transverse guidance information and is the outcome of a great amount of practical and theoretical work carried out primarily by scientists at the Royal Aircraft Establishment, and now adopted as the standard arrangement internationally. As with runway lights, and for the same reasons, approach lights are made with both the high- and low-intensity forms of distribution. They are mounted on supporting poles or structures at various heights depending on the topography of the ground. It is usual for those situated within 1,000ft of the runway threshold to be mounted just above ground level to minimize obstruction to aircraft which may use the area in an emergency.

The taxiways used by aircraft moving between runways and the terminal or maintenance areas are normally lit like runways with two lines of lights marking the edges. There is no requirement, however, for high-intensity taxiway lighting, and the light distribution is not controlled in the horizontal plane except sometimes on curves where the pattern of taxiway lighting would otherwise be confusing. Recent research into the problems of obtaining the best guidance from taxiway lighting suggests that, particularly where the taxiways are wide and the routes complex, it is advantageous to mark the centre line instead of, or in addition to, the two edges. For this to be a practical method, new types of taxiway light are being developed which can be recessed practically flush with the taxiway surface and are strong enough to remain undamaged when run over by heavy aircraft.

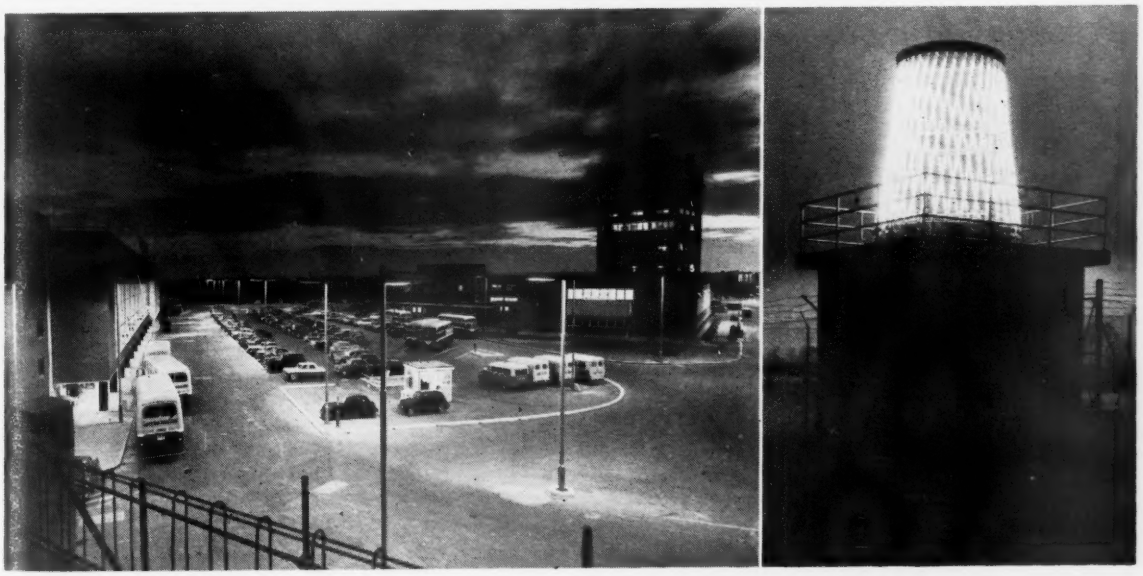


High-intensity approach crossbar at London Airport

It may be mentioned here that both runway and taxiway edge lights are available in either this "semi-flush" or an "elevated" construction. The flush type naturally presents severe mechanical and optical limitations for the design engineer and in general the elevated types are now favoured, since with a given light source a more efficient optical system can be employed. Elevated runway and taxiway lights are normally of a light-weight frangible construction in order to reduce as much as possible the risk of damage to aircraft in the event of a collision, and some designs incorporate a mechanical breakable coupling and plug and socket electrical disconnection at the base.

For maximum efficiency, lighting units invariably employ low-voltage high-efficiency lamps, and often, as in the case of runway circuits, a large number have to be

Cut-off car-park and roadway lighting with fluorescent lanterns, London Airport and (right) the airport identification beacon



Apron floodlighting tower, London Airport

connected together on a circuit extending over a large distance: runways, for instance, vary between 1,000 and 3,000 yd in length.

Series Connection

With lamps ranging from 36 to 200 W, the problems of economical distribution can be best overcome by employing a series system of connection. With this arrangement relatively light cable can be used compared with that required for a parallel or mains-voltage-operated system. The advantages are numerous, the chief of which are:—

(1) Provided the correct current is maintained, all lamps irrespective of distance from the source of supply, run at equal brightness.

(2) By using an isolating transformer with each light, the weakness of the series system is avoided since all transformer primary windings are connected in a series circuit and the failure of any lamp connected to a transformer secondary will not materially affect the remainder.

(3) Fuse protection is not necessary at each light.

(4) Low voltage only at lamp terminals makes it possible to replace lamps on a live circuit.

(5) The main system consisting of the main series cable and isolating transformers in watertight containers can be completely buried and sealed off and need not be disturbed after installation for normal maintenance—an important consideration when often that part of the equipment may be waterlogged for weeks on end. The series circuits are fed by means of special transformers designed to provide the correct series current and incorporating means of varying the brightness of lights by selective tap changing or other means of varying the series current. This control, together with circuit selectors, is exercised remotely from a desk in the tower which is normally provided with means of monitoring the various circuits.

The lights described so far are those which are essential for the landing and take-off of aircraft, but other types for ancillary purposes are also to be found on aerodromes. These consist of light beacons for the visual location and identification of the aerodrome and various items such as illuminated landing direction indicators, illuminated wind sleeves, cloud height indicators, etc.

It is obvious that for positive identification care must be exercised in connection with other lighting such as terminal area, car park and roadway lighting. For instance, there would be a possibility of confusion between street lighting and runway lighting unless steps were taken to eliminate or severely reduce upward light from the former. Street lighting lanterns of the "cut-off" or "aero-screened" types are therefore employed on, and in the immediate vicinity of, aerodromes, and some of the more recent designs provide for either the complete elimination of light above the horizontal or for its reduction to comply with a specification drawn up by the Ministry of Transport and Civil Aviation. It is also noteworthy that, provided sufficient units are employed, the standard of street lighting obtained is of an exceptionally high order. Similarly, the loading aprons in the terminal areas have to be illuminated by means of special floodlights designed not only to eliminate light above the horizontal, but also from other parts of the aerodrome where discomfort could be caused to pilots of taxi-ing aircraft.

Lighting Airport Buildings

Interior lighting of airport buildings can be considered under the two headings of schemes for engineering and technical services, and those for the passenger, baggage handling and Customs areas. The height at which fittings often have to be installed in hangars and workshops makes it important to minimize the frequency with which they

Cold-cathode lighting in the B.O.A.C. maintenance hangar, London Airport

will need attention. Although access can usually be arranged from crane rails, work on aircraft and components often goes on throughout the 24 hours and interruptions should be as few as possible. For such installations, therefore, the long life of cold cathode tubes, now reaching over 15,000 hours in the well-known makes, is highly advantageous.

Of the many other technical premises at an airport, control towers present the special problem of requiring a lighting system that will enable the staff to work and write readily at their desks, while being able to observe aircraft movements at night without interference from reflections in the windows, or difficulty caused by contrast between the level of interior lighting and the darkness outside. Special attention has been given, therefore, to accurate control of light distribution by louvres, and dimming controls may be provided on the desks.

In the passenger areas lighting reflects the modernity of architectural approach which is being given full scope in the design of new buildings, often replacing the temporary accommodation of the immediate post-war years. The trend is towards built-in schemes and recessed ceiling fittings which blend into the clean lines of contemporary architecture. Often the lighting is mainly concealed, but decorative fittings are also included to add interest to the decor.

Cold cathode tubes are widely used because of the ease with which they can be shaped to follow architectural features. Fittings designers are also exploring the decorative use of hot cathode tubes in fittings where the tubes themselves give shape and outline to the design. The new fluorescent colours, such as de luxe warm white, enable tungsten lighting to be used if desired for additional effects with complete harmony between the colours of the two light sources.

All the arts of display lighting are employed in shops and kiosks to catch the eye of travellers with time to spare and perhaps currency in their pockets which in a few hours' time will be no use to them. The over-riding consideration, however, is that the general effect should be conducive to relaxation, and the lighting in line with current standards of illumination for social and business purposes, so that visitors' first and final impressions of a country, if gained at its airports, will be the most favourable.

The British Association

Further Discussions at Bristol

WHEN he addressed Section G—Engineering on 5th September during the annual meeting of the British Association for the Advancement of Science at Bristol, Mr. C. W. Miller (Metropolitan-Vickers) reviewed the development of linear accelerators from the early apparatus giving energies of a few keV to the present very large equipments providing protons up to 50 MeV and electrons up to almost one GeV. Direct acceleration had been shown to be limited to a few MeV energy, but, particularly in the form of the Van de Graaff generator, it found considerable application. For higher energy indirect acceleration was used and here energy would seem to be virtually unlimited and in addition large current and hence power could be provided. There was no theoretical upper limit to energy and it would seem that the limit was only introduced by economics and by the availability of a sufficiently large number of radio-frequency power sources. Extension beyond the energies yet attained for both protons and electrons was clearly obvious.

Future developments might provide other accelerating structures and indeed modified methods of acceleration might arise. An indication of this was the dielectric loaded guide for electron acceleration in which the metallic irises were replaced by similar discs of material of high dielectric constant.

For the highest energy machines comparison with orbital equipments was inevitable. In general, the linear device was usually capable of higher currents, but whether this advantage could be justified on economic grounds depended partly on the actual application and also on the relative state of development of both types of machine at the moment when the decision had to be made. For electron accelerators of a few MeV energy but considerable power output the travelling-wave accelerator appeared to be an almost ideal equipment, and the application of this along with the Van de Graaff accelerator to any industrial processes was a matter which could be expected to produce considerable interest in the next few years.

Dealing with the applications of linear accelerators, Mr. Miller said that most of the equipments he had described had been designed so that their beams might be used either directly or by means of their interaction with a target for pure physical research. There was, however, a more utilitarian application in connection with radiotherapy which was likely to extend both in the use of X-rays and in direct use of electron beams. The use of protons in any field other than pure research would at present seem unlikely; the only possible application would seem to be for the production of short-lived isotopes or those which could not be produced by irradiation or as a fission product in a nuclear reactor. There appeared to be several applications for electron accelerators, especially for equipments of relatively modest energy. For radiotherapy Van de Graaff equipments and travelling-wave linear accelerators were already in routine use in certain hospitals. For industrial radiography similar equipment was needed, and for the examination of heavy and thick objects energies of a few MeV were required along with large X-ray outputs; the 4 MeV travelling-wave linear accelerator provided an almost ideal equipment for this purpose.

There were two further possible applications of electron accelerators which appeared to offer great promise for the future. One was the application of the sterilizing action of ionization radiations and the other the irradiation of certain plastics.

Particle Accelerators

In a subsequent review of accelerating machines for nuclear particles, Dr. J. B. Adams (European Council of Nuclear Research, Geneva), gave an account of development of machines designed to produce high-energy particles for nuclear physics research, including a description of the proton synchrotron of the European Council of Nuclear Research.

There existed, he said, a common misunderstanding that

high-energy particle accelerators were directly connected with atomic energy and that their development was therefore helping to provide atomic energy power stations. It was true that the lower-energy accelerators did play some part in the atomic energy research programme, but the really high-energy machines were built to further research that had no immediate practical application. Nobody could say how the results of this work would affect atomic energy or any other branch of applied science in the future, and for the moment the results only increased our knowledge of the fundamental particles that went to make up our universe.

Commenting on future developments, Dr. Adams said that recent machines were of such a size that they took about six years to build. Soon after a project got under way, new ideas were already being proposed for the next machine. Despite the way in which the energy of these machines had increased over the years, there was no sign that the ingenuity of the designers was failing. There was a long way to go before the highest energies observed in the cosmic rays were reached. The cost of machines against energy clearly demonstrated how the advance in energy was being gained for ever smaller increases in cost. The asymptote was the amount of money that it seemed reasonable to ask from a government for this branch of fundamental research.

In general, it could be concluded that the ingenuity of the designers would find a method of increasing the energy of machines above the present 30 GeV projects at a cost not very much greater than at present committed for the 30 GeV machines. This could only be done at the expense of closer tolerances on all parts of the machine and was therefore dependent, as always, on technological developments.

Scientific Education

At a joint meeting of the Physics and Education Sections, Sir Philip Morris, C.B.E. (Vice-Chancellor of Bristol University) spoke on "A Scientific Education." The problem, he said, was complicated by two interrelated causes. First, the vast increases in the map of knowledge, which had been mainly scientific in nature; and secondly, the greatly increased significance of knowledge, especially scientific knowledge, in a complex and interdependent world of highly organized economic and social units.

Those who had created a suitable environment and laid the foundation of rudimentary skills in the primary stage of education had been notably successful, but the aim and scope of education in the succeeding span of four years was dimly apprehended.

To allow the child's own interests to develop, the first four or five years of a secondary school must provide a balance between the linguistic, the mathematical and the scientific. He assumed that a well-balanced education, comprising religious knowledge, English, history, geography, a foreign language, mathematics, science and either music or art or both was the objective at which we should aim, and that to attain our purpose we should be willing to modify anything that patently stood in the way of its achievement.

Several questions arose, of which the main concern was with two. First, what was to be the scope and objective of mathematical teaching? How vital was mathematical knowledge and in what precise sense was mathematical knowledge essential to progress in scientific subjects? Secondly, was it right that sciences should be taught, at this stage, as separate subjects? He regarded it as being of the greatest educational importance that every pupil should at this stage of his or her secondary education, acquire or at any rate learn about the scientist's outlook on the physical universe.

Universities certainly had their problems. Scientific teaching in universities was based upon honours or special schools and they in turn were influenced by what were thought to be the requirements of post-graduate education. Was this structure right or ought it to be examined from first principles? Further, could we ignore the great influence of relying so exclusively on research as the means of post-graduate training and education?

Professor N. F. Mott (Cavendish Professor of Physics at Cambridge) in a paper on "Specialization in School and University," thought it was desirable that the decision to read science should be made as late as possible in a boy's time at school. A boy with a talent in English or modern languages who chose science had to drop them at 16, or sometimes even earlier. He thought that if boys were given the chance to turn to science at 16 or even later, more would do it. He believed that more people, able to exercise leadership in any field of activity, would then come into science and exercise it there.

He suggested that an ambitious university, with its reputation still to make, should set up a strong intermediate course as the basis of a four-year course for students who opted late for science.

The problem of breaking down excessive specialization was urgent indeed. He knew that many of his friends at Cambridge would welcome suggestions from schools as to how this might be achieved, because experiments in solutions could only be made by groups of schools and university people working together.

In a paper "Education through Physics," Professor F. A. Vick (Physics Department, University College, Keele, Staffs) said that it should be possible to devise a university course containing physics as a major component to stand alongside Greats and Modern Greats available for the education of our future civil servants, politicians and industrialists. Scientists would have much more confidence in administrations containing a reasonable proportion of men who had taken a Science Greats course.

Furnace Luminous Radiation

Professor M. W. Thring (Professor of Fuel Technology and Chemical Engineering, Sheffield), in a paper to the Physics Section entitled "Luminous Flame Radiation," said that the ability to predict luminous radiation in large heated tube boilers, open hearth furnaces and other flame-heated systems was of great importance to the engineer because the extent of luminous radiation might affect the output of the system by a factor of 2 and the efficiency by 10 or 20 per cent. There was a great gap between fundamental laboratory work on luminous radiation and the knowledge available to the engineer, because luminous radiation depended essentially on heat transfer proceeding during combustion, so that it was not possible to scale down the size of the experiment very much.

The expense of building a furnace purely for research had prevented this gap being filled in any one country, but shortly after the war it had been found that by pooling resources, both financial and experimental, between England, France and Holland, experiments on the required scale could be carried out. A furnace nearly 7ft square and 30ft long had been constructed for the research. Experiments with it had led to accurate formulæ for predicting the length of the flame, a knowledge of how to improve the efficiency of burners, a knowledge of the effect of fuel type on luminosity and of the effect of aero-dynamic mixing conditions on luminosity.

Steps were now being taken towards the development of a complete formula for predicting luminosity and the range

of the work was being extended to new fuels, particularly pulverized coal. The experimental results had also made it possible to develop a theory for predicting heat transfer in the open hearth furnace which had been tested by a special experimental cast.

Shift Working

On 6th September, in a paper on the economics of shift working, Mr. F. R. Eels (Sheffield University) said that an inquiry carried out among large numbers of firms in the North of England and the North Midlands showed that most firms were interested in shifts primarily as a means of increasing output rather than as a way of reducing costs. Although they wished to obtain this output with as little capital expenditure as possible, it was significant that output was nearly always the first thing they mentioned.

Firms which introduced shift systems were nearly always firms which were expanding. It followed that the managements preferred day and night shifts rather than double day-shifts because the former system enabled them to work overtime when there was a pressure of work, whereas the hours of double day-shifts were rigid.

Another group of firms had been asked why they did not use shifts, and three-quarters of them said that shortage of labour was the only reason.

It was wasteful for industrial plant to stand idle for 16 hours out of every 24 as well as week-ends. By using it more fully we should have greater output in relation to capital employed. There could also be greater production for the same overhead costs. The greater the output that had been obtained from a plant in a given time the more ready would the owner be to replace it when it was becoming old, and this would have a beneficial effect on our productivity and competitive strength.

Shift work was more difficult to start than it was to run once started. A major problem was to persuade the existing employees not to leave at the time of the change-over. Any shift work, even if not involving work all night, caused a good deal of disturbance in the normal routine of life. Dislike of night work was so widespread that it was remarkable there had been so little organized demand for double day-shifts to replace day and night working.

The question was often asked whether we were justified in disturbing family life by shift working for the sake of economic advantage. The reply was that the cause of the workers would not be served by letting us fall behind in the economic race, and that the best hope for us all was in a general rise in the standard of living. We might not be willing, for social reasons, to have 24-hour working, but we could not afford, for economic reasons, to use machinery for less than 16 hours a day. Industrial plant was continually becoming more complex and expensive, and we should be imposing a burden on ourselves as compared with other countries if we did not make our plant produce as much as possible while it was still up to date.

Lighting and Vision

In Section I—Physiology, on Wednesday, 7th September, there was a symposium of papers on lighting and vision. In the first paper Mr. H. C. Weston (Medical Research Council) reviewed some researches in recent years to determine the conditions of lighting desirable for various purposes on physiological and psychological grounds.

On the whole, it could be said that recent researches on lighting, besides adding to our knowledge of the photometric quantities and their distribution which were necessary for visual efficiency, had added emphasis to the notion that conditions of lighting should be consistent with the comfort of those exposed to them. There were those to-day who maintained that lighting should achieve more than this; in fact, that it should be a source of pleasure in its own right.

In conclusion, it might be remarked that much current lighting practice fell far short of what we now knew it ought to be. Although in some fields great improvements in lighting had been brought about in the last decade, still many of our homes, schools, offices, factories, streets and other places needed better lighting. Occasionally, startling evidence of bad practice appeared. For example, only three months ago a patient had died in a hospital in lighting which was so poor that the signs of his urgent need for succour could not be seen. A very few years ago 24 boys had been killed en masse on a badly lighted road by a vehicle with inadequate lights. Not only on roads but in other situations also bad lighting might even be worse than no lighting at all; it was sometimes not merely ineffectual but a positive menace.

"Brightness Engineering"

The next paper by Messrs. W. R. Stevens and C. A. P. Foxell (General Electric Co.) described fundamental research into the seeing capabilities of the human eye under different conditions of brightness. This science of "brightness engineering" was of great importance to lighting specialists, particularly when they were concerned with providing adequate illumination for close work in factories and offices.

The authors drew the conclusion that the eye could still distinguish very fine detail under lighting which was far more intense than that normally used in interiors. The best conditions for seeing details were that the object should be brightly illuminated, which was obvious, and that the surround should be of about the same brightness, which was not so obvious. Furthermore, it had been shown that quite a small surround of the requisite brightness, making an angle with the eye of no more than about five degrees, was sufficient for good acuity. This corresponded to a width of about one inch at the normal distance for viewing close work.

The test object used for experiments was a Landolt broken circle, which was a photographic reproduction of a ring with a small gap in it. The ring was revolved at high speed and then stopped with the gap in any one of eight positions—top, top right, right, and so on. The observer was then required to state the position of the gap under a variety of conditions of illumination and size of gap. About 100,000 observations had been made during the course of the tests and an additional 30,000 had been made with coloured test objects.

One of the important physiological aspects to which this work had drawn attention was in connection with the structure of the eye. The angle subtended by the gap at the observer's eye was in some experiments as low as 0·7 minute of arc, or one two-hundredth of a degree. It was thought that this ability of the eye to resolve ultra-fine detail might not be in complete accord with existing ideas as to the eye's structure, but this question was outside the scope of the paper.

Dr. W. F. Floyd of Middlesex Hospital Medical School, then spoke on "Some Effects of Filament and of Fluorescent Lighting on Visual Performance." There were, he said, two important differences between filament and fluorescent light: firstly, a colour difference, and secondly the presence of flicker with fluorescent lighting.

The colour of filament lighting was usually described as yellow, and was due to the paucity of blue in its spectrum.

The flicker obtained with fluorescent tubes was due to the rhythmic extinction of the fluorescence which occurred under normal operating conditions, on a.c. mains, twice during each cycle of the mains supply, giving a flicker

frequency of twice the supply mains frequency. The situation was rather more complex than this, however. Due to the occurrence of rectification in the discharge tubes the flicker from fluorescent tubes might contain an appreciable component at 50 per second, as had been shown by Brett in 1948.

Flicker, even if not directly perceived, as at lower frequencies, might have its effect on physiological function. It had been claimed that the electroencephalogram was modified in some people during exposure to illumination containing a substantial flicker element, even at a frequency of 100/sec. The evidence, however, was slender. The flicker from filament lamps operated on 50 c/s a.c. mains supplies was usually too small to be perceived or to have any physiological effects.

Experiments showed that the type of illuminant (filament or fluorescent) did not affect performance. The experiments had further shown that the 100 c/s flicker element of fluorescent lighting also did not affect performance. Inasmuch as the tests used correlated positively with performance at clerical and similar tasks, clerical or fine clerical work involving visual acuity of a few minutes of arc appeared to be carried out as effectively in fluorescent lighting as in filament lighting of equal illumination level. The conclusions were valid within the range of illumination levels studied, namely, 5-20 lumens/sq ft.

The final paper of the symposium, on "Lighting and the Visual Confidence of Road Users" was by Mr. J. G. Holmes of Holophane, Ltd. He said that although the human retina was very sensitive in the dark, the structure of our eyes and the requirements of our brains called for illumination levels well above the threshold in order to permit rapid recognition of unfamiliar surroundings. This was particularly true on the roads at night. A principal problem in the provision of lights on vehicles or in the streets was to place the lamps and to distribute the light in such ways that the road user, driver or pedestrian, could comprehend his environment quickly and certainly.

One function of vehicle or street lighting was to evoke a motor response in threading a safe way through a pattern of signals, obstructions and impending collisions; this was a task involving both instinctive reaction and judgment.

The visual information received through the rods in the retina was perhaps more closely associated with instinctive reactions and that received through the cones with deliberate judgment and action. The pedestrian or motorist who failed to solve his problems quickly enough either lacked the judgment which would lead to recognition and action or might be regarded as having failed to evolve to survival in modern traffic conditions.

So many people and so many hazards were competing for the observer's attention. As new means of giving visual information were developed, lights were given special colours or shapes or made to flash on and off, or put in unusual places so as to become more conspicuous and emphatic. Advertisements, signals, floodlights, warning lights, street lights, reflectors, high-intensity "spot" lights—all these and others formed a confusing medley from which it might be impossible to select the important information by instinct and amongst which the critical warning might be masked in spite of the observer's discriminating judgment. It was sometimes a relief to get into an "undeveloped" area but it was a temptation then to assume that because less could be seen there was less danger.

On several subjects, experiments had given results which were at variance with popular views. Coloured lights did not penetrate fog better than white but they might lower the brightnesses sufficiently to reduce glare; white headlamps were better for the driver and no worse for anyone else; better vision was given by dipped headlamps on approaching cars than by sidelights only; flashing lamp direction indications took much longer to recognize and interpret than semaphore indicators; improved street lighting made little difference to speed but reduced the frequency of accidents. In spite of the economic limitations on street lighting, these results and others might be used to reduce the discomfort and danger of using the road.

There was little to be enjoyed in the night-time view of a traffic route and the function of all lighting on the streets was primarily to promote security and to reduce mental strain.

Geothermal Power in New Zealand

From Our Own Correspondent

WORLD interest has been aroused by plans to use New Zealand's geothermal steam to produce heavy water for Britain's atomic development and for electricity. Important as the heavy water project is to the British Commonwealth, New Zealanders, especially those in the North Island, are more interested in the electricity side of the scheme, because the North Island power supply will be short of the demand by 1958.

Development of water resources in the island, which has the bulk of the country's population and manufacturing industries, has fallen behind schedule mainly because of labour shortages. North Islanders have viewed geothermal steam as providing an assured source of power to meet long-term needs. But a statement by Dr. W. M. Hamilton, head of the Department of Scientific and Industrial Research, has caused surprise and apprehension. Dr. Hamilton said that geothermal energy could not provide enough power to meet the long-term requirements of the North Island unless generation greatly exceeded current estimates. He estimated the total known geothermal steam potential at Wairakei, site of the combined heavy water and electricity project of the British and New Zealand Governments, as only 136,600 kW, sufficient to take care of only one year's rise in demand. (The initial power plant at Wairakei will produce 40,000 kW.) He said that power potential from other geothermal sources was expected to total 475,000 kW. He did not include the world-famous thermal resorts of Rotorua and Whakarewarewa in this reckoning because of their value as tourist attractions.

Dr. Hamilton believed that full use of Wairakei steam would almost certainly cause all surface thermal activity to cease, as it did at Lardarello, Italy. Eventually, New Zealand must look to coal-burning generating stations, nuclear power, or other sources to meet the rapidly increasing demand for electricity, which on past experience would double in less than ten years. Full use of geothermal power as an alternative to coal-fired generating stations might well mean a saving of £5 million a year.

The Minister in charge of the State Hydro-Electric Department, Mr. Stanley Goosman, has said that Dr. Hamilton's conclusions were only a "form of guess." Mr. Goosman said that they would not know anything until they put down the Wairakei bores.

The North Island is rapidly approaching maximum use of its water resources for power production. Apart from one or two small hydro-electric plants, and two obsolete coal generating stations, most of the island's power comes from the Waikato River. The South Island is in a much happier position. It has had its share of power restrictions, but can look forward to a period of plenty when the 320,000 kW Roxburgh project on the Clutha River is completed. This island has immense water reserves in its lakes and rivers. North Island people hope that Dr. Hamilton's estimate of geothermal power resources is the result of scientific caution, and that much more power will be forthcoming from the bores Mr. Goosman says he will keep on putting down.

VIEWS on the NEWS

By REFLECTOR

EVEN by television the Blackpool illuminations, which were switched on by Mr. Malik, the Russian Ambassador, were very impressive. I think that the Mayor was a little too impressive when, introducing Mr. Malik, he said that he was not only switching on the lights of Blackpool but the lights of the world. We were told by the B.B.C. commentators that there was 50 million candle-power of light and that the annual cost was £75,000, but we were not told who was responsible for planning and running the illuminations. This is the task, very successfully accomplished, of Mr. H. Carpenter, M.I.E.E., the Blackpool Corporation's illuminations and public street lighting officer, who has held this post since 1950.

* * *

It strikes me that Dr. J. Bronowski expects too much from the man in the street. At the British Association meeting last week he deprecated the general lack of scientific knowledge, saying (according to the *News Chronicle*) that

> "The switchboard and the motor car, the treatment of flour and cigarette paper, the building of a crèche and of an atomic pile are our daily concerns."

Dr. Bronowski seems to be judging the ordinary individual by his own high standard, which is a little unfair; there is far too much to be learned—there always was. The difference is, I suppose, that there are more things to-day which make an immediate impact upon everyday life and yet remain mysterious to the general public. The effect upon most people is to frighten them into concentration upon their own narrow affairs and leave the rest to the "experts."

* * *

Discussion of power plant nomenclature and usage is proceeding in the United States. Writing to the *Electrical World*, Mr. Weller H. Colburn, of the Boston Edison Co., deprecates the rating of boilers in megawatts (an American, not a British practice); he says that he has never seen a boiler put out a megawatt and, in fact, he has never seen a megawatt. Another correspondent, Mr. C. B. Phillips, a combustion engineer, quarrels with the use of "boiler" instead of "steam generator." He rightly says that the modern so-called boiler unit consists of a great deal more than just a boiler. There is a superheater which contributes a very large proportion of the energy of the steam as well as an economizer and air heater, none of which is in any sense a boiler. Mr. Phillips also deprecates the application of megawatts to boiler outputs.

* * *

Sir William Hayter, the British Ambassador to Moscow, with other members of the *Corps diplomatique*, recently inspected the Russians' atomic power station which is said to have been in operation since June last year. They found the station in "a sylvan setting of great pine forests" (not spoiling the "amenities" I hope) and saw that it had "a classic façade with house martins nesting under the eaves." One would have expected to see robins.

* * *

It is the general impression here that snow and ice are not part of the Australian scene. Yet an Australian correspondent tells me that during the last week or two employees at the Guthega Dam in the Snowy River hydro-electric scheme, which is in the Australian Southern Alps, have been skiing to work. The weather there has been so cold that ice a foot thick covers the water above the dam site. But in spite of severe blizzards the men have continued and work in the tunnel is proceeding. Snowy River is not misnamed.

* * *

Electricians at an aircraft factory are reported to have ceased work to enforce a demand for 3d an hour "incentive money" in addition to the regular rate for night work. It has also been suggested that bus conductors should be given a bonus for collecting passengers' fares. Nowadays, it seems, the ordinary rates of pay are often regarded merely as retaining fees.

* * *

An electricity consumer, writing to the *Evening News*, says that as his bill for the June quarter was double that for the previous one he protested and was told that the meter might have been over-read slightly but he would benefit correspondingly in his next account. He goes on to assert that

> "it was also pointed out that the meter reader was a very short person and perhaps he had been unable to read the figures properly."

Surely the Board could afford to equip diminutive meter readers with step-ladders or binoculars.

* * *

From the *Electrical Review* of 15th September, 1875:—

> "Mr. George Robinson has patented a new process for sawing wood. The process consists in substituting a platinum wire for the saw. The wire is heated to a white heat by the passage of an electric current. The wire, to which a forward and backward movement is given, cuts across the hardest woods with inconceivable ease. The platinum wire, constantly maintained at a white heat by the electric current, advances in the wood by carbonizing the surface which it touches, but this carbonization is entirely superficial and has no bad effect."

This was interesting as an early electric tool but the cost of replacing the blade, and it must have had to be replaced quite often, was probably too much for the saw's survival.

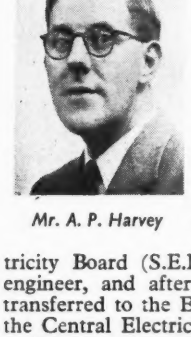
PERSONAL AND SOCIAL

News of Men and Women of the Industry

The Minister of Fuel and Power has reappointed the following chairmen of Electricity Consultative Councils:—South Eastern: **Alderman Commander D. S. E. Thompson,** R.N. (Retired), of Whitstable. South Western: **Lady Carew Pole,** of Torpoint, Cornwall. Merseyside and North Wales: **Mr. H. Evans,** J.P., of Liverpool. Yorkshire: **Alderman W. Leach,** of Barnsley. North Western: **Councillor F. Kenyon,** J.P., of Oldham.

Sir Percy H. Mills, the first president of the Institute of Industrial Supervisors, who played a prominent part in the Institute's foundation in 1948, will be going to America in September to receive the Edward O. Seits Memorial Award for International Management, presented by the National Association of Foremen of America. Sir Percy was selected by the National Association of Foremen board of directors " for his furthering of the N.A.F. high ideals for management in foreign industry." Sir Percy is the first Englishman to receive this award.

Mr. A. P. Harvey, A.M.I.E.E., has been appointed chief engineer, Switchgear Division, Brush Electrical Engineering Co., Ltd., in succession to Mr. V. W. Lowe. Mr. Harvey received his training with A. Reyrolle & Co., and in 1934 joined their technical and research department. In 1945 he went to the Central Electricity Board (S.E.E.) as a technical engineer, and after vesting day was transferred to the Eastern Division of the Central Electricity Authority as a regional technical engineer. He joined the Brush Co. in 1953 and since then has been responsible for the design and development of the company's switchgear products.

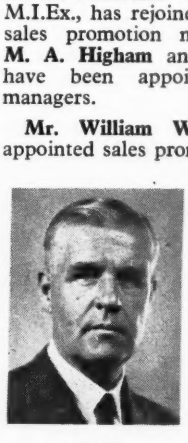


Mr. A. P. Harvey

Mr. H. C. Maguire, manager of the Liverpool depot of the Marconi International Marine Communication Co., Ltd., has been appointed to the new post of export sales manager, created in view of the continually increasing volume of overseas business, carried on through the company's associates abroad, in radio communication and navigational aid equipment.

Mr. L. Abrahams has relinquished his position as sales manager of Clang, Ltd., to commence business on his own account. **Mr. R. D. Mason,** M.I.Ex., has rejoined the company as sales promotion manager and **Mr. M. A. Higham** and **Mr. H. Martin** have been appointed joint sales managers.

Mr. William Webster has been appointed sales promotion manager of the radio and electrical group of Brown Brothers, Ltd. Mr. Webster, who has had many years' experience in these trades, is operating from the head office of the company in London, where he took up his appointment on 1st September.

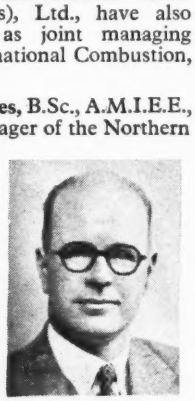


Mr. W. Webster

As from 30th September, **Mr. H. W. Swann,** O.B.E., M.I.E.E., D.F.H.(Hons.), will be relinquishing his directorship of Chilton Electric Products, Ltd., but will continue to serve the company in the capacity of consultant.

Mr. Vernon Young, F.C.I.S., has been appointed chairman of International Combustion, Ltd. **Mr. Walter Grainger,** M.Inst.F., and **Mr. John Mayer,** B.Sc., A.M.I.Mech.E., who were recently appointed joint managing directors of International Combustion (Holdings), Ltd., have also been appointed as joint managing directors of International Combustion, Ltd.

Mr. J. T. Sharples, B.Sc., A.M.I.E.E., until recently manager of the Northern Area branch of Barlow-Whitney, Ltd., has been appointed manager of the main plant of the company at Bletchley, Bucks. Mr. Sharples is succeeded as district manager by **Mr. G. H. Toller,** who will continue to operate from the company's northern office at 32, Deansgate, Manchester.



Mr. J. T. Sharples

Mr. A. J. Morley has joined Thorn Electrical Industries, Ltd. Previously he was with Electronic Tubes, Ltd., having occupied the position of general sales manager during the past four years.

Mr. R. Swift, who since 1946 has been works director of Gent & Co., Ltd., Leicester, has been appointed managing director to succeed Mr. H. Kelvin Parsons, whose death we reported in our 19th August issue. Mr. Swift joined the company in 1920 but left for a time to obtain experience with other Leicester firms. He returned to Gent & Co. in 1928 as machine shop foreman and in 1940 became production manager. Two years later he was appointed works manager and in 1946 he became works director.

Mr. E. O. Chapman has been appointed sales manager of Gent & Co. He joined the company in 1926 as an apprentice and after six years was made foreman of the Clock Department. During the war he was closely connected with the Admiralty on Asdic apparatus and for his work in this connection was awarded the B.E.M. in 1943. Mr. Chapman has been responsible for a number of developments on the horological side of Gent & Co.'s business and was made sales manager of the Clock Division in 1949.

Mr. E. O. Chapman

Mr. P. Miller has been appointed London manager of the company. He takes up his new post on 20th September. For a number of years he has been in charge of the Estimating Department, and was previously in charge of a production department at the works.

Mr. J. J. Allen has been appointed engineer-in-charge of the new Channel Islands television transmitting station at Les Platons, Jersey, which is now in an advanced state of construction. Mr. Allen joined the B.B.C. in 1939 and served in the Engineering Equipment Department. Since 1953 he has been with the Planning and Installation Department, where he has been engaged on installation work at a number of the Corporation's television transmitting stations.

The appointment of **Mr. W. Balfour** as engineer-in-charge of the new television transmitting station under construction at Meldrum, Aberdeenshire, is also announced. He will continue to be responsible for the Home Service transmitting station at Redmoss and the Aberdeen studios. He joined the B.B.C. in 1934 as an

assistant maintenance engineer at the Washford transmitting station and later served at the Daventry and Westerglen transmitting stations. In 1937 he joined the Superintendent Engineer, Transmitters Department, in London, where he remained until his appointment as engineer-in-charge, Aberdeen and Redmoss, in 1950.

Mr. H. F. Bowden, who becomes engineer-in-charge of the short-wave transmitting station at Skelton, Cumberland, following the retirement of Mr. S. A. Williams, M.B.E., joined the Corporation in 1926 as an assistant maintenance engineer in London. He subsequently served as a maintenance engineer, and later as a senior maintenance engineer, at a number of B.B.C. high-power transmitting stations. In 1942 he became the assistant engineer-in-charge of the short-wave transmitting station at Rampisham, Dorset, and in 1945 of the Skelton short-wave transmitting station.

Mr. W. J. Harper has been appointed by the A.A. Electrical Co., Ltd., as technical representative covering the areas of the Yorkshire, Merseyside and North Wales, North Western and North Eastern Electricity Boards. He will be engaged in the preparation of technical schemes for power factor correction using diphenyl pentachloride capacitors.

Mr. D. W. Kent, B.A.(Cantab), A.C.A., whose appointment as managing director of the Igranic Electric Co., Ltd., we briefly announced last week, took up his duties at the beginning of September. Educated at Charterhouse and Trinity College, Cambridge, he received his early training with Spicer & Pegler, accountants, and joined the Igranic Electric Co. in 1936 as chief accountant, subsequently becoming secretary and a director in 1945. In October, 1953, Mr. Kent was appointed a director of an associated company, Sentinel (Shrewsbury), Ltd., which position he relinquished on rejoining the Igranic Electric Co.

Mr. D. W. Kent

Mr. S. H. Parker has joined Teddington Industrial Equipment, Ltd., as general manager. Mr. Parker was formerly general sales manager of Sunvic Controls, Ltd.

The annual swimming gala of the Northmet Sub-Area of the **Eastern Electricity Board** took place at Wood Green Baths on 9th September, when clubs from twelve districts and departments competed. In the men's championship B. Henderson (New Southgate) won by a narrow margin from the previous holder, L. Clayden (Tottenham). Miss P. Willoughby (Northmet House), with a time of 52·9 sec, set up a record for the ladies' championship.

A dinner-dance and cabaret will be held by the **Royal Engineers' Association, London Group,** on 1st October at the Chatham Room, Victoria Station, London, S.W.1 (7 for 7.30 p.m.). Tickets (12s 6d each) can be obtained from Mr. J. S. Pearson, Room 31, Horse Guards, Whitehall, S.W.1.

There was a large attendance at last Tuesday's monthly luncheon of the **Electrical Industries Club.** On this occasion the president, Mr. Leslie C. Gamage, delivered his inaugural address. In this Mr. Gamage dealt with the country's trade situation and spoke from his experience as a world traveller of the best ways of meeting overseas customers' needs. He also stressed the importance of the home market as a basis for export trade and the necessity to reduce costs and improve production to meet the increasing competition of trade rivals. Mr. Gamage was very critical of the Monopolies Commission and the trade unions' demands for ever-increasing wages.

The **E.I.B.A. Hants and Dorset Branch** is holding a ball at the South Parade Pier, Southsea, on 18th November, to celebrate the golden jubilee year of the Association. Tickets (15s each) may be obtained from the branch hon. secretary, Mr. G. H. Jones, c/o Central Electricity Authority, 111, High Street, Portsmouth.

A car treasure hunt was recently arranged by the Midlands Branch of the **Electrical Trades' Commercial Travellers' Association** and was attended by over seventy members and friends. The route was confined chiefly to the pleasant district of Clent, near Birmingham, and afterwards tea was provided at Hagley Hall. The prizewinners were: First, Mr. W. Swift; second, Mr. F. Walton; and third, Mr. A. Peters. The annual dinner of the branch will be held at the Queen's Hotel, Birmingham, on 28th October next.

OBITUARY

Mr. M. G. Bland.—The death on 7th September is reported of Mr. Maurice George Bland, O.B.E., M.I.C.E., M.I.E.E., of Chartfield Avenue, Putney. Mr. Bland was a consultant and was at one time in partnership with Mr. H. Bourne as Albion T. Snell & Partners. He had served in the London Electrical Engineers, R.E.(T.).

Mr. J. Scrivener.—The death occurred on 8th September, at the age of seventy-four, of Mr. James Scrivener, a former managing director and vice-chairman of Electrolux, Ltd. It was in 1919 that Mr. Scrivener obtained the selling agency in Britain for Electrolux cleaners and so started a career that was to see the formation of Electrolux, Ltd., in 1921 and the opening at Luton five years later of the domestic refrigerator and suction cleaner factories. Mr. Scrivener retired from the board of the company in 1952 and had been living in retirement at Felpham. Early last year he was made a Knight of the Royal Order of Vasa (First Class), a Swedish honour, for his work in furthering Anglo-Swedish trade relations.

Mr. L. N. Vine.—The death occurred at Bexhill on 28th August of Mr. Leslie Newton Vine, B.Sc., A.C.G.I., A.M.I.E.E. He was sixty-nine years of age.

WILLS

Mr. R. Grierson, M.I.E.E., M.I.Mech.E., retired heating engineer to the Eastern Electricity Board and managing director of Grierson, Ltd., 1922-36, who died on 5th June last, left £12,182 gross (£12,078 net).

Sir Richard W. Allen, C.B.E., D.L., M.Inst.C.E., chairman of W. H. Allen, Sons & Co., Ltd., who died on 17th July last, left £327,655 gross (£326,436 net).

Lt.-Col. Hon. G. A. Akers-Douglas, director of Philips Electrical, Ltd., Philips Electrical Industries, Ltd., and other companies, who died on 11th July last, left £210,290 gross (£204,315 net).

INTERNATIONAL BANK LOANS

In its report for the year ended June last the International Bank for Reconstruction and Development says that the total amount lent by the Bank during the year was about $410 million in the form of twenty loans to fourteen countries, including loans to the value of some $110 million to eight countries for power development. Among these were loans of $30 million and $22 million, respectively, to Italy and Austria for hydro-electric schemes. Good progress was made with projects financed by earlier loans (at 30th June the total expenditure out of loans made by the Bank amounted to almost $1,680 million). New capacity brought into operation during the year totalled more than 1,000 MW, including nearly 400 MW in South Africa and Southern Rhodesia.

ELECTRICAL INDUSTRIES BALL

The Electrical Industries Benevolent Association is holding its annual ball, as usual, on the second Friday in November, which this year is the 11th of the month. The rendezvous is again the Great Room at Grosvenor House, Park Lane. Geraldo and his Embassy Orchestra will play for the dancing, and there will be a midnight entertainment. Tickets at 2¼ guineas each can now be obtained from the Association at 32, Old Burlington Street, London, W.1, to whom applications with remittances should be addressed without delay.

Brit.I.R.E. Premium Awards

The Council of the British Institution of Radio Engineers has announced the recipients of Institution Premiums for papers published during 1954, and for papers read at the Industrial Electronics Convention held at Oxford in July, 1954.

The premier award, the *Clerk Maxwell Premium*, is to be presented to Mr. F. N. H. Robinson, M.A. (Clarendon Laboratory, Oxford), for his paper on "Microwave Shot Noise in Electron Beams and the Minimum Noise Factor of Travelling Wave Tubes and Klystrons." Other awards are as follows:—*Heinrich Hertz Premium*: Dr. T. B. Tomlinson (formerly at the University of Southampton), for his paper on "Partition Components of Flicker Noise." *Louis Sterling Premium*: Mr. L. H. Bedford, O.B.E., M.A., B.Sc. (Marconi's Wireless Telegraph Co., Ltd.), for a paper on "Problems of Television Cameras and Camera Tubes." *Sir J. C. Bose Premium*: Mr. S. Deb, M.Sc. (Institute of Radio Physics and Electronics, Calcutta University), for "Decay of Emission from an Oxide-Coated Cathode due to Absorption of Matter Liberated from the Anode." *Brabazon Premium*: Messrs. J. W. Jenkins, J. H. Evans, G. A. G. Wallace and D. Chambers, B.Sc. (A. C. Cossor, Ltd.), for "A High-Definition General-Purpose Radar." *Marconi Premium*: Mr. W. T. Brown (British Telecommunications Research, Ltd.), for "Some Factors in the Engineering Design of V.h.f. Multi-Channel Telephone Equipment." *Leslie McMichael Premium*: Dr. G. N. Patchett (Bradford Technical College), for "A Critical Review of Synchronizing Separators with Particular Reference to Correct Interlacing." *Students' Premium*: Mr. R. W. Walker (King's College, Newcastle-upon-Tyne), for "An Electronic Random Selector."

Awards of premiums are to be made to the authors of papers read at the Industrial Electronics Convention as follows:—*Session 1—Electronic Computers*: Mr. P. Huggins (Sargrove Electronics, Ltd.), for "Statistical Computers as Applied to Industrial Control." *Session 2—X-rays and Sonics*: Mr. C. W. Miller, M.Sc. (Metropolitan-Vickers Electrical Co., Ltd.), for "Industrial Radiography and the Linear Accelerator." *Session 3—Nucleonics*: Messrs. K. Kandiah, M.A., B.Sc., and D. W. Chambers (Atomic Energy Research Establishment), for "Multi-Electrode Counting Tubes." *Session 4—Transducers*: Mr. J. L. Thompson (J. Langham Thompson, Ltd.), for "Wire Strain-Gauge Transducers for the Measurement of Pressure, Force, Displacement and Acceleration." *Session 5—Process Control*: Mr. M. T. Elvy (Redifon, Ltd.), for "Electronic Heating and the Woodworking Industry."

The following awards have been made for the 1954 Graduateship Examination:—*President's Prize*: Mr. P. J. Murray. *Electronic Measurements Prize*: Mr. A. D. Brown.

THE TENSOR CLUB

During the visit to this country of Mr. Gabriel Kron, patron of the Tensor Club of Great Britain, lecture courses are being arranged at the Imperial College of Science and Technology (7th and 8th October) and King's College, London University (10th to 14th October); details of the lectures can be obtained respectively from Mr. M. W. Humphrey Davies, Electrical Engineering Department, City and Guilds College, Exhibition Road, South Kensington, S.W.7 and Mr. B. Adkins at the same address. From 17th to 21st October Mr. Kron will be visiting and will lecture in Rugby, Manchester and Liverpool.

The joint organizers of the Tensor Club are Dr. W. S. Gibbs, 53, Hillmorton Road, Rugby, and Mr. S. Austen Stigant, 7, Courtlands Avenue, Hayes, Kent.

Street Lighting Schemes

BLACKPOOL Corporation Highways Committee is to improve the street lighting in the town centre at an estimated cost of £14,710, and a scheme for the replacement of further gas street lighting by electricity on carriageways in the central area at an estimated cost of £62,400 has been approved.

BLYTH (Northumberland) Corporation is carrying out the third stage of its scheme for installing electric street lighting throughout the area. This year's phase will cost about £3,600 and the next area to be dealt with will be Seaton Sluice. Main streets are being supplied first, and side streets will be dealt with later.

The estimated cost of converting all gas lamps in CALNE (Wilts) is £3,843.

CHESTER City Council Improvement Committee has recommended the adoption of the scheme of the Merseyside and North Wales Electricity Board for the conversion of street lighting in Hoole from gas to electricity for the sum of £11,294.

The Minister of Transport is being asked to approve a £59,000 scheme of electric street lighting at DAGENHAM. It is proposed that 1,772 electric lighting units shall replace 1,188 gas lighting units over about fifty-five miles of roads.

LEICESTER City Council is recommended to approve in principle a scheme, estimated to cost £100,000, for the conversion to electricity of all the gas street lighting in the City, and to seek sanction to borrow the sum of £10,000 for the carrying out of the first phase of the scheme.

The MIDDLESBROUGH Town Council is to spend over £12,000 installing sodium vapour lighting on the east-west cross-town main traffic route to replace the present obsolete low-pressure gas lighting. The tender of the North Eastern Electricity Board at £4,932 has been accepted for the electrical work. It is also proposed to spend £6,300 on the provision of similar lighting in Acklam Road and the tender of the North Eastern Electricity Board at £1,530 has been accepted for the electrical work.

A ten-year scheme for converting NEWCASTLE-ON-TYNE'S 10,000 gas lamps to electricity is being considered by the City Council. The first stage of the work, involving 1,079 street lamps, will cost over £37,000, but the change-over will reduce running costs by £4,112 per annum.

The Ministry of Transport and Civil Aviation has approved a scheme, estimated to cost £13,600, for improved street lighting installations at ORMSKIRK and BURSCOUGH.

REDCAR (Yorks) Town Council has decided to go ahead with plans to convert the lighting system of its promenade to electricity next year. It was argued that electric lighting was necessary if the sea front was to become a showpiece, and that better general lighting would lead to improved all-the-year-round trade.

A £32,000 scheme for fluorescent lighting of Knightsbridge, Piccadilly, Coventry Street and seven other streets in WESTMINSTER is to be carried out by the City Council. It is planned to complete the work by 31st March next year.

USKMOUTH PROJECT

Because of the possible effect on young salmon, the Uskmouth River Board on Monday decided against approving the Central Electricity Authority's plan to construct a second power station at Uskmouth, Mon, work on which, according to the original programme, should have started at the beginning of this year. The C.E.A. proposes to draw 15 million gal/hr from the river for the new station and as the water would be returned at a higher temperature the Board fears that in the spawning season young salmon might be destroyed. The Board has agreed to meet representatives of the Authority and the Ministry of Fuel and Power to discuss the matter.

Engineering in Europe

Abstracts from Foreign Technical Journals

CLASS "A" winding insulation of electric motors usually consists of varnished cloth between two layers of electric pressboard (fish or rag paper). The use of three layers of insulating materials in the slot creates a danger of air interstices being formed between the winding and the laminations of the stator and results in a deterioration of the thermal conductivity and moisture-proofness of the insulation despite its varnish impregnation. For this, and for economic reasons, a new special insulating material for slots of Class "A" motors was developed and has become known as laminated electric pressboard. This material consists of electric pressboard bonded by tri-acetate sheet. As bonding agents, varnishes of the poly-acrylate type, or mixtures of glyphthal and phthalic tri-ethylene glycol varnishes are used. The varnishes are applied in concentrations of 75-80 per cent which prevents warping of the pressboard under an excess of solvent.

The new material is produced on a machine of the conveyor type on which the operations of varnish coating, drying and bonding of tri-acetate sheet and support can be combined. Electric motors with a slot insulation of this laminated pressboard possess a higher insulation resistance at a relative humidity of 95 per cent and a temperature of 125 deg C than motors with the conventional varnish cloth-paper insulation and are equivalent to motors with more expensive varnished silk and cloth insulation.—"Laminated Electric Pressboard, a New Insulating Material," Ya. L. Shugal and S. I. Smirnova, *Elektrichestvo*, No. 5, pp. 59-61, 1955, in Russian.

Vacuum Bushings

Modern vacuum engineering comprises a number of special problems which sometimes tend to be difficult owing to conflicting mechanical and thermal strength requirements and a comparatively great disparity of various materials going into a composite body. A particularly delicate case is that of ceramic vacuum bushings used in large rectifier units, since the ceramic body and its metal fittings have obviously very different thermal expansion coefficients as well as tensile and compressive strengths, yet must be held together and vacuum-sealed throughout the range of operating temperatures and pressures. This problem can only be solved by a judicious matching of materials so as to reduce the stresses on the fused seals to the minimum, but also combined with a particularly careful design of the bushing and its fittings and a special technique of sealing. Theoretical considerations and calculations can only be used as approximate indications to help the designer, but cannot provide the complete solution. However, the article represents the step-by-step process leading to an actual technical solution of the intricate problem very lucidly.—"Design of Ceramic Vacuum Bushings Considering the Stressing of the Fusion Seals," J. Ibl, *Elektrotech. Obzor*, Vol. 44, No. 6, pp. 318-324, 1955, in Czech.

Television Interference

The sources of interference with television reception may be divided into three groups, the first of which are those emitting undamped h.f. oscillations of discrete frequencies and comprising most of the modern medical and industrial h.f. equipments and the oscillators of superhet radio receivers; these constitute the sinusoidal disturbances causing the "moiré" pattern on the television screen. If the interfering carrier frequency is modulated, as is mostly the case, the moiré pattern shows the irregular distribution of the mains hum.

The second group of disturbances is characterized by damped, pulse-type h.f. oscillations with a wide frequency spectrum and is due to l.f. switching pulses set up by sparking commutators of electrical machines or flashovers on faulted h.v. insulators. The number of spark discharges determines the number of distorting pulses per second. This is mostly above 100/sec and therefore above the frame or picture frequency. The interference effect is magnified by the inertia of the adjustment of the human eye.

The third group of sources of interference is formed only by the ignition system of i.c. engines and is similar in effect to those of the second group, only of a lower frequency which also is variable with the engine speed. Long-, medium- and short-wave interferences are mostly transmitted through mains, whereas u.h.f. are mainly radiated by the aerials. The author describes a set-up for measuring u.h.f. interference and discusses various tentative classifications and criteria for permissible and inadmissible interference voltages submitted to international bodies.—"Interference with TV Reception and its Measurement," W. Scholz, *E.T.Z.(A)*, Vol. 76, No. 10, pp. 337-339, 11th May, 1955, in German.

L.V. Ceramic Capacitors

The conditions to be satisfied by h.f. equipment and its component parts are becoming more severe with the higher frequencies being used and also with the variations of temperature and moisture of the ambiences in which they are used. It has been found that despite many advantages of modern ceramic capacitor types, their performance is not always satisfactory, especially if they contain titanium oxides, because the temperature coefficient of their capacitance is not constant, the permissible field strength is strongly dependent on the humidity of the air and the loss-angle-frequency relation is also not satisfactory. Another undesirable and sometimes very troublesome phenomenon is the so-called flicker effect which, however, could be traced back to the electrodes deposited on the dielectric by some metallizing process rather than to the dielectric itself. It is now established that the stability of the capacitance of a capacitor also depends on a suitable type of solder used for the leads.

The new types of h.f. capacitors developed following detailed investigations are tubular, which is advantageous for the deposition of silver electrodes of the required homogeneity and stability to prevent flicker. They have a "wall thickness" (thickness of the dielectric) assuring maximum specific capacitance (referred to volume) and optimum utilization of the dielectric strength of the ceramic material, do not require hermetic sealing and are flicker-free. Other new types of capacitors described are disciform, including ferro-electric ceramic capacitors of a specific capacitance up to 300,000 pF/cm^3.—"New Developments in the Field of Ceramic L.V. Capacitors," N. P. Bogoroditskii and L. D. Fridberg, *Elektrichestvo*, No. 6, pp. 37-42, 1955, in Russian.

News from India

From Our Bombay Correspondent

INDIA will be spending £1,000 million annually for the next five years, according to a report of the Planning Commission published recently. About 70 per cent of the total outlay will come from central finances, the rest being provided by private capital. The total investment is roughly double that in the first five-year plan, although this time the accent is more on heavy industries and mining, which will take up almost a quarter of the total outlay as compared with roughly 8 per cent in the past. Transport and communications come next with about 22 per cent, and irrigation and agriculture follow close behind. Power development will take up about 11 per cent, and the rest will be spent on construction and social services. Although direct expenditure on power is only about 10 per cent of the total, it is clear that a fairly large slice of the expenditure on heavy and light industries will be on electrical machinery and equipment. Roughly speaking, it has been calculated that about £400 million will be spent each year for the next five years on purchases under the heading of " electrical."

A detailed analysis reveals that about a third of the industrial investment will be on the three new iron and steel works that are planned, bringing the total to five. Heavy machinery to fabricate plants for steel and producer goods will take up about £120 million and the projected factory for manufacturing heavy electrical equipment will cost about £30 million. Small-scale industries, many of which will be in the " electrical " sphere, will have £150 million spent on them.

The development plans, if fulfilled, will almost double current production, and in some cases, as in steel, will quadruple it. Finished steel is to be increased to 5 million tons per year from the current level of just over a million, cement 10 million tons (from the present 4 million), aluminium 40,000 tons (4,000), electrical goods by 66 per cent, heavy chemicals by 200 per cent and coal by 60 million tons (36 million). Another 4,000 miles of permanent way will be added to the railways. The installed capacity of power stations is to be increased to 6 million kW from the present 2·8 million kW. It is estimated that by 1961 India will be producing about 15,000 million kWh a year as compared with the present 7,000 million kWh.

Preliminary studies indicate that foreign aid to the extent of about £100 million a year will be required. This implies a net investment of about 11 per cent of national income, a figure most Indian economists consider too ambitious, and there has been fairly widespread criticism of the plan, but Mr. Nehru has announced that this is the least the country can do if it is to maintain itself above the perpetual poverty line. The foreign aid figure of about £500 million sounds rather forbidding at first sight, but it is said that over £300 million worth of assistance was received for the first plan and that an increase of two-thirds is quite possible. The plan, which has yet to be officially adopted, will cover the five-year period beginning April, 1956.

A project for the installation of 20,000 to 30,000 windmills costing about £6 million has been drawn up by the Council of Scientific and Industrial Research which has recently been experimenting on a pilot scale on low-cost windmills for Indian villages away from the main State grids. The windmills will be used mainly for lift irrigation (in India about 90 per cent of rural power is absorbed by lift irrigation schemes) and for small-scale industries. The windmill designed by the Council is chiefly a bamboo-and-timber affair and costs about £75, the imported product being twice or three times as costly. It is estimated that to irrigate 500,000 acres of small farm area in the country about 100,000 windmills are required and this will be the ultimate target to be reached over a period of ten years, involving an outlay of about £20 million.

Indian electrical manufacturers are displaying considerable uneasiness over the decision of the Government to take up the manufacture of heavy electrical equipment without the collaboration, financial or otherwise, of private manufacturers in the field. This matter was referred to recently by Mr. L. P. Shah, chairman of the Indian Electrical Manufacturers' Association (see *Electrical Review*, 5th August, page 242).

Meanwhile, the Association's report states that two more factories for manufacturing transformers are being built, raising the plant production capacity to 600,000 kVA. By 1960 it should be 1,000,000 kVA and transformers up to 10,000 kVA will be made in the country. Paper-insulated power cables are not being produced in India but a scheme of the Indian Cable Co. has been approved by the Government. In its ultimate stage it will have a capacity of the order of 600 miles of cables per year.

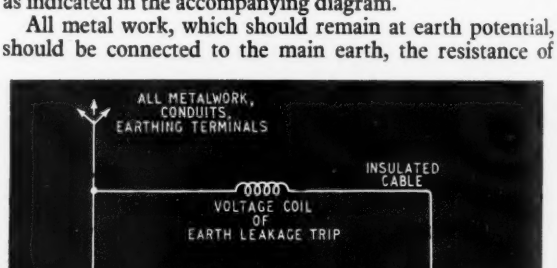
LETTER TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents

Selective Earthing Protection

I HAVE read with interest the article by Mr. T. C. Gilbert about the E.C.A. specification and fully agree with his remarks about cables, as I feel that polythene or p.v.c. insulated cables with wire armouring or metal braiding terminating in suitable glands will prove very useful. Protection against corrosion of the armour can be obtained by a further p.v.c. sheath. On the subject of earthing methods, I consider that selective protection of individual circuits can be obtained when using one main voltage operated earth leakage trip, the voltage coil being connected as indicated in the accompanying diagram.

All metal work, which should remain at earth potential, should be connected to the main earth, the resistance of



Selective protection of individual circuits can be obtained when using one main voltage operated earth leakage trip with the voltage coil connected as above

which should be made as low as possible by connecting earth plates, rods, water pipes, etc., so that even if there is no piped water supply the earth resistance may be of the order of 5 ohms or less. The voltage coil should then be connected with insulated cable to an auxiliary earth rod which should be outside the sphere of influence of the main earth. Selective protection will then be provided by the individual fuses or circuit-breakers and the short period earth faults of minor importance will not affect the supply. The earth leakage trip will only be operated by a major fault or a fault occurring when, for some reason, the main earth resistance is high.

Witham, Essex. D. YOUATT, A.M.I.E.E.

I.E.E. London Meetings

Programme for the First Half of the 1955–56 *Session*

WITHIN the next few weeks, the London and Provincial meetings of the Institution of Electrical Engineers for the 1955-56 Session will be in full swing. In London the Session opens on 6th October with the Presidential Address by Sir George Nelson, Bt. Following our custom we list below the ordinary meetings and the meetings of the specialized Sections which will be held at the London headquarters during the first half of the Session. In addition to the meetings given below members should note that a British Nuclear Energy Conference will be held on 30th November at the Institution of Civil Engineers, Great George Street, Westminster, S.W.1. Sir Christopher Hinton will give the opening address and lecturers will be Sir John Cockcroft, Mr. V. A. Pask and Mr. J. A. Duckworth, Mr. H. J. Grout, and Mr. A. S. McLean and Dr. W. H. Marley.

ORDINARY MEETINGS

6th October: Inaugural Address as President, by Sir George H. Nelson, Bt. 3rd November: "The New High-Frequency Transmitting Station at Rugby," by Captain C. F. Booth and B. N. MacLarty (Radio and Telecommunication Section paper). 10th November: "Germanium and Silicon Power Rectifiers," by T. H. Kinman, G. A. Carrick, R. G. Hibberd and A. J. Blundell (Utilization Section paper). 1st December: "TRIDAC—A Large Analogue Computing Machine," by Lt.-Cdr. F. R. J. Spearman, J. J. Gait, A. V. Hemingway and R. W. Hynes (Measurement and Control Section paper). 5th January, 1956: "Highland Water Power—The Developments of the North of Scotland Hydro-Electric Board," by the late T. Lawrie, to be read by an officer of the Board (Supply Section paper).

INFORMAL MEETINGS

17th October: Discussion on "Railway Signalling," opened by J. H. Fraser. 14th November: Discussion on "Is the Engineer Broad Enough in His Outlook?" opened by Dr. P. Dunsheath. 5th December: Discussion on "Private Generation from the Point of View of the User," opened by A. N. Irens. 9th January, 1956: Discussion on "The Efficient Use of Technical Personnel," opened by the President.

EDUCATION DISCUSSION CIRCLE

18th October: Discussion on "Analogues and Equivalent Circuits," opened by W. A. Turner. 7th November: Discussion on "Lagrange's Principle as the Basis of a Unified Treatment of the Action of Electrical Indicating Instruments," opened by D. Rutenburg. 9th December: Discussion on "Aids to Teaching the Subject of Windings in Rotating Machinery," opened by F. Stefani. 10th January, 1956: Discussion on "Teaching Electrical Engineering to Mechanical Engineering Students," opened by H. E. Dance (Joint meeting with the Education Group of the Institution of Mechanical Engineers).

RADIO AND TELECOMMUNICATION SECTION

19th October: Chairman's Address, by H. Stanesby. 31st October: "The Technique of Ionospheric Investigation using Ground Back-Scatter" and "A Study of Ionospheric Propagation by means of Ground Back-Scatter," by E. D. R. Shearman. "An Experiment to Test the Reciprocal Radio Transmission Conditions over an Ionospheric Path of 740 km," by R. W. Meadows. "An Experimental Test of Reciprocal Transmission over Two Long-Distance High-Frequency Radio Circuits," by F. J. M. Laver and H. Stanesby. "V.h.f. Propagation by Ionospheric Scattering and its Application to Long-Distance Communication," by W. J. Bray, Dr. J. A. Saxton, R. W. White and G. W. Luscombe. 9th November: "A Transistor Digital Fast Multiplier with Magneto-Strictive Storage," by Dr. G. B. B. Chaplin, R. E. Hayes and A. R. Owens. 21st November: Discussion on "The Reception of Band I and Band III Television Programmes," opened by E. P. Wethey. 7th December: "Some Half-Tone Storage Tubes," by R. S. Webley, Dr. Ing, H. G. Lubszynski and J. A. Lodge. 12th December: Informal lecture on "The Television Studio as seen by the Producer," by Alvin Rakoff. 11th January, 1956: "Pulse-Time-Modulation Terminals for Music Transmission over Radio Links," by R. F. Rous.

MEASUREMENT AND CONTROL SECTION

11th October: Chairman's Address, by W. Bamford. 25th October: "An Electrostatic Particle Accelerator," by D. R. Chick and D. P. R. Petrie, and "An Electrostatic Analyser for the Absolute Measurement of Proton Energies and the Establishment of Fixed Points on the High-Voltage Scale," by Dr. S. E. Hunt, D. P. R. Petrie, K. Firth and A. J. Trott. 1st November: Discussion on "Fault Recording Instrumentation on a Power Supply System," opened by W. Casson and Laszlo Csuros. 8th November: Section Dinner (at the Café Royal). 17th January, 1956: "A new Meter for the kVA Demand Charge," by P. Baxter. 31st January: Discussion on "The Design and Use of Electrical Measuring Instruments for Arduous Conditions of Service," opened by C. A. Oldham and G. N. Harding.

SUPPLY SECTION

26th October: Chairman's Address, by L. Drucquer. 16th November: Discussion on "Thermal Rating of Transformers," opened by R. A. Grierson. 23rd November: "Flat Pressure Cable," by J. S. Mollerhoj, A. M. Morgan and C. T. W. Sutton. 14th December: "The Measurement of Steam Temperatures in Power Stations," by D. H. Lucas and M. E. Peplow.

UTILIZATION SECTION

13th October: Chairman's Address, by D. B. Hogg. 17th November: "Timing the Operation of Control Systems Associated with Rotating Equipment," by C. Cuthbert and D. A. Picken, and "The Dynamic Braking of Induction Motors," by Dr. D. Harrison. 15th December: "Intensification of the X-Ray Image in Industrial Radiology," by Dr. A. Nemet and W. F. Cox. 18th January, 1956: Section dinner-dance (at the Café Royal). 19th January: "Age and the Incidence of Fires in Electrical Installations," by L. Gosland.

JOINT MEETINGS

Measurement and Radio Sections. 15th November: "An Electrolytic-Tank Equipment for the Determination of Electron Trajectories, Potential and Gradient" and "A Method of Tracing Electron Trajectories in Crossed Electric and Magnetic Fields," by Dr. D. L. Hollway (papers to be read by Dr. J. H. Westcott). Measurement and Radio Sections. 29th November: "The Specification of the Properties of the Thermistor as a Circuit Element in Very-Low-Frequency Systems," and "A Vector Method for Amplitude-Modulated Signals," by Dr. C. J. N. Candy. Measurement and Utilization Sections. 6th December: "The Instrumentation of a 14-inch Experimental Rolling Mill," by S. S. Carlisle and G. W. Alderton. 6th January, 1956: "Power Station Auxiliary Plant," by G. F. Kennedy and F. J. Hutchinson (Joint meeting with the Institution of Mechanical Engineers, at 1, Birdcage Walk, S.W.1). 16th January: Papers on "Advanced Courses for Engineers in Industry," by Dr. Willis Jackson, H. D. Morgan and Prof. G. F. Mucklow (Joint meeting with the Institutions of Civil and Mechanical Engineers, at 1, Birdcage Walk, S.W.1). Radio and Measurement Sections. 23rd January: Informal lecture on "Particle Accelerators," by E. L. Wiblin.

INDUSTRIAL NEWS

Purchase Tax Notices

The following notices issued by the Commissioners of Customs and Excise have been revised: Notice No. 78—"Goods chargeable with Purchase Tax," and Notice No. 78D—"Scope of Groups 1 to 9 of the Tax Schedule and 'D' relief for apparel, textiles, soft furnishings and bedding." Copies of the new editions are being sent to all traders registered for Purchase Tax purposes and to trade associations. The revised Notice No. 78 supersedes the issue dated April, 1954, and also Notices Nos. 78H and 78J dated April, 1955, and May, 1955, respectively. The revised edition of Notice No. 78D supersedes the issue dated February, 1953.

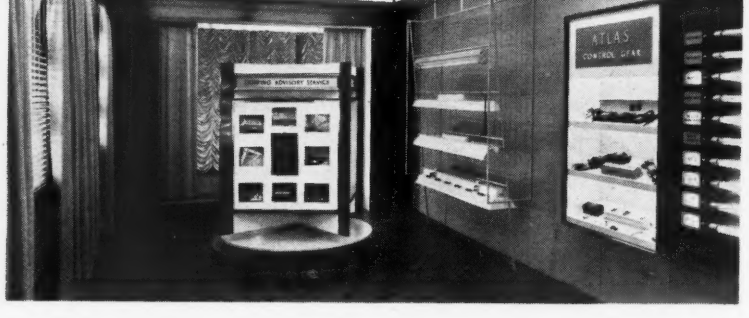
Birmingham Lighting Showrooms

A miniature stage, suitable for demonstrations of modern theatre lighting, is one of many interesting features of the new Midland area showrooms of the Atlas Lighting Division of Thorn Electrical Industries, Ltd. The premises at 24, Sheepcote Street, Birmingham, provide facilities for showing Atlas products in pleasant contemporary surroundings and are specially equipped to demonstrate electronically controlled fluorescent colour lighting. The Atlas automatic dimmer-unit may be used to control either the lighting of the stage, or a three-colour group of fluorescent tubes in a cornice in the showroom ceiling. Both the stage and the indirect ceiling installation give a wide range of colour effects and can be operated manually as well as on the automatic dimmer.

A colour-comparator, each section of which is large enough to be dressed as a shop window, can be used to demonstrate the effects of different light sources and tube colours on food, fabrics and other merchandise. There is a representative range of fluorescent and incandescent fittings, including a selection of industrial fittings and louvred ceilings. A further display is devoted to control gear and accessories, while a fluorescent tube colour demonstration board gives opportunities of comparing the various tubes side by side.

In the same building an area of over 7,500 sq ft is devoted to warehouse accommodation for Atlas lighting products, all ingoing and outgoing goods being transported by overhead conveyors. There is a section for the products of other Thorn Divisions, and excellent under-cover loading facilities are provided for the company's transport fleet.

Part of the new showrooms of the Atlas Lighting Division at Birmingham



Cable Price Increases

Members of the Rubber and Thermoplastic Cable Manufacturers' Association have found it necessary to increase the prices of all types of rubber and thermoplastic insulated cables, wires and flexible cords as follows:—All types other than armoured and lead covered and armoured cables, 5 per cent; all armoured and lead covered and armoured cables, 2½ per cent. The revised prices came into force on 8th September.

Boilers for Pretoria

An order, valued at over £1 million, has been received by Yarrow & Co., Ltd., Glasgow, for three land boilers and equipment for the Pretoria "B" power station, South Africa. This follows three previous orders for the existing seven Yarrow boilers at the power station.

Philips Fluorescent Lamps

Philips Electrical, Ltd., has renamed its current range of fluorescent lamps as follows, the previous titles being shown in parentheses:—Colour matching (colour matching); cool white (daylight); cool white de-luxe (natural); white (MCF/U and MCFA/U only); warm white (new warm white); and warm white de-luxe (de-luxe warm white). The change has been made to enable users to get a reasonably accurate idea of the apparent colour and the colour rendering properties of any lamp in the range.

"Crypton News"

Crypton Equipment, Ltd., has published the first issue of "Crypton News." This publication is designed to provide distributors of garage equipment with easy-to-understand and practical information about the company's products. This first issue refers to battery testing and charging apparatus, engine testing and tuning equipment and electrical shop service equipment.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM Ingots	ton £171 0s 0d
COPPER, H.C. Electro	ton £385 10s 0d
Fire Refined 99·70%	ton £384 0s 0d
Fire Refined 99·50%	ton £383 0s 0d
COPPER Tubes ..	lb 3s 9½d
Sheet	ton £463 10s 0d
H.C. wire and strip ..	ton £442 10s 0d
LEAD, English ..	ton £107 15s 0d
Foreign	ton £106 0s 0d
MERCURY	flask £95 0s 0d
TIN, block (English) ..	ton £744 15s 0d
ZINC, G.O.B. Foreign	ton £92 15s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 2s 11⅛d
Sheet	ton £356 10s 0d
Wire	lb 3s 6½d
PHOSPHOR BRONZE Wire	lb 5s 3⅜d
PLATINUM	oz £29 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 42¾d—43d

Plant for Geo-Thermal Power Station

An order valued at £750,000 has just been received by the British Thomson-Houston Co., Ltd., from the New Zealand Government (on behalf of the New Zealand Ministry of Works) for five steam turbo-alternator sets for installation at the Wairakei geo-

thermal power station (see page 536). It is here, in the north island of New Zealand, that a vast project is being developed to produce heavy water, which is used as a moderator in nuclear reactors.

Two of the sets will be of the back-pressure type, driven by steam from thermal boreholes at 180 lb/sq in gauge and 380 deg F, the steam being exhausted at 50 lb/sq in gauge into the heavy water plant. The remaining three sets will use the same steam after it has passed through the heavy water plant; these sets are being designed for steam conditions of 15 lb/sq in abs. and 213 deg F, and will exhaust into jet condensing plants supplied by the Mirrlees Watson Co., Ltd. The consulting engineers are Messrs. Merz & McLellan.

Tube Investments Research

The establishment of an applied research station at Walsall to supplement facilities already available at its research laboratories at Cambridge and Birmingham is announced by Tube Investments, Ltd. The new station, to be opened early in October, will initially house three sections of the group's Technological Department, which acts as a bridge between fundamental scientific work and its practical application in the group's operating companies.

The Irradiated Materials Section at Walsall will be directed by Mr. A. Charlesby, D.Sc., Ph.D., formerly of the Atomic Energy Research Establishment, Harwell. Its development work will cover a wide field, but will be particularly concerned with irradiated plastics. The materials will be irradiated in the first instance at the Tube Investments Research Laboratories, at Hinxton Hall, Cambridge, where an electron accelerator is now being installed.

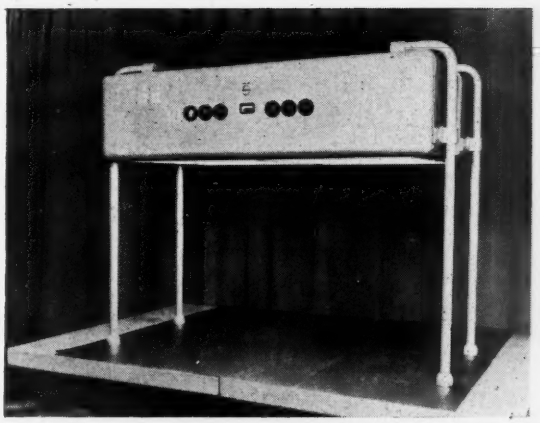
The Plastics Development Section will be directed by Mr. J. E. Gordon, B.Sc., formerly head of the plastics development organization at the Royal Aircraft Establishment, Farnborough. This section will be concerned with the development of processes and the necessary machines to be used in the plastics industry to take advantage of the chemical advances of recent times, to the streamlining of production techniques, and its impact upon end-product design.

A further team at Walsall will operate under the direction of Mr. C. A. Cochrane, M.A., and will be concerned with control engineering, including the application of electronic techniques to industrial processes.

Colour-matching Unit

Many industries have found that the colour constancy of natural daylight is insufficient to permit of accurate colour-matching. This is due to the varying distance which light rays from the sun travel through the atmosphere as the apparent altitude of the sun changes. The greater this distance, the wider is the diffusion of the blue rays of the spectrum and, hence, the greater the red content of the light reaching the earth. Cloud formations, atmospheric dust, etc., also affect both colour and intensity.

Philips Electrical, Ltd., have recently supplied a leading firm of colour printers with a newly-developed lighting unit, specially designed for the matching of colours, which by employing a number of carefully selected light sources, mounted in a single fitting, provides constant colour illumination of substantially the same spectral composition as natural daylight from a clear northern sky at noon on a March day. The apparent colour temperature of the combined source is 10,000 deg K. The fitting consists of a number of fluorescent lamps housed in a reflector casing.



Philips colour-matching unit

Switchgear Contracts

Contracts have recently been secured by Ferguson, Pailin, Ltd., for a number of substation metalclad switchboards to the order of H.H. the Ruler of Kuwait, through Messrs. Ewbank & Partners, Ltd. These switchboards are for 11 kV service and for breaking capacities ranging from 250 to 500 MVA. The switchgear is required to reinforce the existing power distribution system in Kuwait, the Subah Gate and Salimieh stations constituting the "feed in" points from the 33 kV system.

Another large order for the Kintore substation of the North of Scotland Hydro-Electric Board covers a combined eight-circuit 132 kV and ten-circuit 33 kV switching station including associated control and ancillary apparatus. This station will eventually be a keypoint linking the 275 kV and 132 kV grids. The consultants are Messrs. Merz & McLellan.

Conference Organizers to Meet

Over a thousand conferences are held each year in Great Britain. Requirements vary according to the needs of each organization and full co-operation and co-ordination are essential to success. The first Conference of Conference Organizers is to be held at Harrogate from 21st to 24th October. Mr. J. W. Simpson, O.B.E., secretary of the British Electrical Power Convention, has taken a leading part in the initiation of the conference.

Diesel-Electric Shunters

Currently being tested and commissioned by British Railways are ten diesel-electric shunting locomotives with power units comprising Crompton Parkinson electric traction equipment and Crossley prime movers. Mechanically, these locomotives are to British Railways' familiar standard 0-6-0, 350 h.p. design.

The power unit consists of a six-

The South Western Electricity Board's stand at the recent Plymouth Productivity Exhibition. Special attention was paid to industrial heating, including floor warming, infra-red and high-frequency; saving of effort by the use of electric tools; and electronic apparatus. A photo-electric counting device was installed at the entrance to the stand

cylinder two-cycle scavenge pump diesel-engine, a single bearing generator of the self-ventilated pattern and two axle-hung, nose-suspended traction motors. A belt-driven auxiliary generator has been provided which is mounted on the main generator. The maximum tractive effort provided by the power unit is 35,000 lb, the continuous tractive effort is 15,400 lb at about 5½ m.p.h., while the maximum speed of these 46-ton locomotives is 20 m.p.h.

Industrial Accident Prevention

The Minister of Labour, Sir Walter Monckton, and three leading industrialists are to speak on the urgent necessity to reduce the number of accidents occurring in British industry at a one-day conference to be opened by the Lord Mayor of London at the Guildhall on 28th October. The conference is being organized by the London Industrial Co-ordinating Committee which represents five industrial accident prevention groups who work in and around London. The Industrial Safety Division of the Royal Society for the Prevention of Accidents is also closely associated with the conference. It is the principal event of National Industrial Safety Week, during which a campaign for safer working in British industry is being launched. The object of the campaign is to encourage all workers, but particularly young workers, to "start a safety habit to-day," and to remember that "safety habits last a lifetime." During the launching week it is hoped to introduce these two slogans into every factory, large or small, throughout the United Kingdom.

Admission to the conference is by tickets only; these may be obtained from the hon. treasurer, Mr. H. Meanley, North Thames Gas Board, Kings Road, Fulham, London, S.W.6, at 10s 6d each.

New Clubhouse

A well-planned and spacious clubhouse has just been built by the Electrical Apparatus Co., Ltd., St. Albans, to cater for the needs of the greatly increased numbers of factory and staff personnel. The clubhouse, which adjoins the works, has a main hall of striking design and roomy proportions. It is provided with a specially laid dance floor which can be covered when not in use. There is also a directors' dining room, a restaurant, billiards room and sports changing rooms complete with showers, etc. Kitchens of modern plan are equipped with up-to-date culinary equipment with stainless steel furniture and special extract ventilating apparatus. The clubhouse is wired with a high fidelity sound equipment with v.h.f. radio receiver and two special line source speakers to overcome all acoustic difficulties in the main hall.

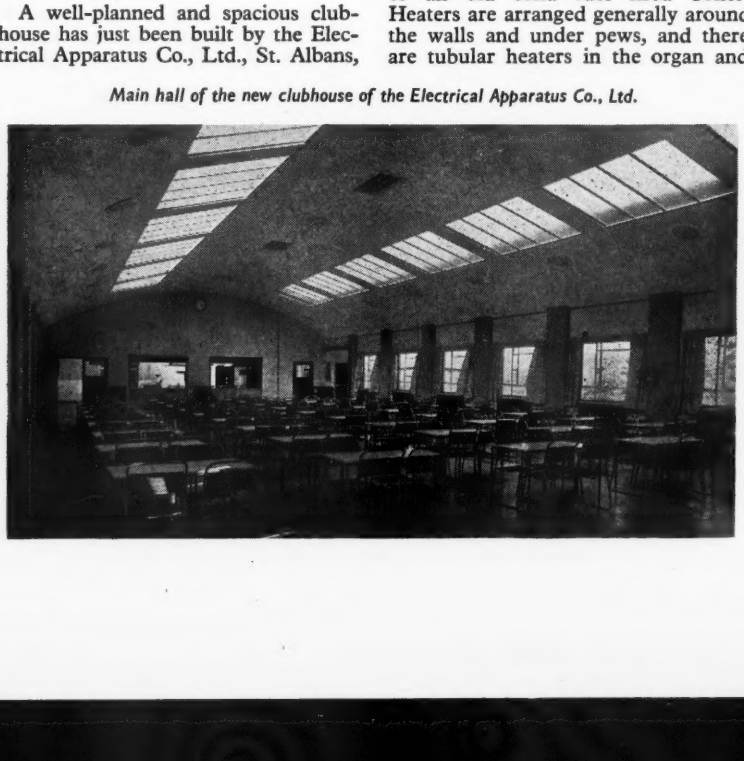
Electric Heating in Lancashire

Members of the North Western Division of the National Smoke Abatement Society on 2nd September paid a visit, sponsored by the North Western Electricity Board, to electric heating installations in the Manchester, Bury and Blackburn areas.

In a Manchester office the visitors saw how radiators and pipe work of an old solid fuel fired boiler had been retained and the boilers replaced by electrically heated hot water thermal storage equipment, which consumes electricity only during off-peak hours and so obtains the advantage of lower rates of charge. At a new Manchester garage they saw 7,500 sq ft of floor space heated by an electric low temperature radiant floor warming system. Heating panels here are completely concealed in the floor and thermostatic controls have been installed to maintain automatically internal comfort level in showroom, staircase, corridors and offices. This system also is able to take advantage of off-peak operation.

At St. Anne's Church, Tottington, which was built in 1799, electric tubular heaters have taken the place of an old solid fuel fired boiler. Heaters are arranged generally around the walls and under pews, and there are tubular heaters in the organ and panel heaters in the vestries. Most of the heaters are controlled by time switch and thermostat. Electric heating of Blackburn Cathedral has been introduced in stages as building has proceeded. Fifteen years ago an electrode boiler was introduced for the existing cathedral buildings, and a further boiler of the same loading was installed during 1952. Radiators are placed close to walls and at the foot of the pillars, while to overcome the natural chimney effect to be found in a lofty building of this kind, carefully camouflaged heating pipes are run round the capitals of the pillars.

Main hall of the new clubhouse of the Electrical Apparatus Co., Ltd.



Electricity at the Dairy Show

The exhibit of the British Electrical Development Association at this year's Dairy Show (Olympia, 25th to 28th October) will deal with the applications of electricity on a typical dairy farm having a herd of thirty cows. It is assumed that on this particular farm full use is made of electricity and that the bucket milking system is used. Equipment will be displayed covering the various uses of electricity in the dairy itself and also in connection with rearing of calves, ensuring adequate water supplies and the preparation of feeding stuffs for the livestock. A display of lighting fittings particularly suitable for dairy installations will also be shown on the stand.

Atomic Power Plant

Already C. A. Parsons & Co., Ltd., are providing the power plant for the first section of the Calder Hall atomic power station which consists of four turbo-generators, each with an output exceeding 20 MW, with accompanying condensers and auxiliaries, eight large gas circulators, two dump condensers and the cooling gas duct-work. Recently orders have been placed with the company for the plant for the second section of the Calder Hall station which will be similar in all respects to the first section.

In addition orders have been received for the plant for a second atomic power station at Chapel Cross in Dumfriesshire. This will consist of a further eight turbo-generators each with an output exceeding 20 MW. The experience thus gained in the nuclear field will be of great value to the Nuclear Power Plant Co., Ltd., of which the company is a member.

Ultra-violet-ray Exhibition

An exhibition with the theme "Ultra-violet Rays in Industry and Commerce" is being held at the Chester Street, Aston, Birmingham, showrooms of the Midlands Electricity Board (Sutton Coldfield and N.E. Birmingham District) from 3rd to 14th October.

Llandudno Electrical Exhibition

The Merseyside and North Wales Electricity Board is to stage an electrical exhibition, which will include the model of the nuclear power station

recently shown at the Geneva Atomic Convention, at Llandudno from 26th September to 1st October. Also on show will be a model of the proposed Rheidol hydro-electric station. The exhibition is being arranged in connection with the UNIPEDE Conference.

English Electric Plant for Hong Kong

The English Electric Co., Ltd., has been awarded a contract, valued at approximately 25 million Hong Kong dollars, by the Hong Kong Electric Co., Ltd. The contract covers the construction of a power station, to be known as North Point "B," adjacent to the existing power station. The ultimate capacity will be 180,000 kW.

The English Electric Co. is the main contractor and the engineering and co-ordination of the whole contract will be carried out by its General Engineering Projects Department, London. The company will supply, erect and set into operation a 30,000 kW 600 lb/sq in 850 deg F, 3,000 r.p.m. steam turbo-alternator set as well as the switchgear, the transformers and all the other electrical and auxiliary equipment. Generation will be at 11.8 kV, stepped up through a 37,500 kVA transformer feeding into the Hong Kong Company's distribution network at 22 kV.

The main sub-contractors are George Wimpey & Co., Ltd., Babcock & Wilcox, Ltd., and British Insulated Callender's Cables, Ltd.

Electricity in Nigeria

We published in our issue of 5th August an article from a Lagos correspondent on "Electricity in Nigeria." We are now informed by the Acting Director of the Department of Commerce and Industry in Lagos that this article was taken word for word from one published in the October-December, 1953, issue of the *Nigeria Trade Journal* (an official publication).

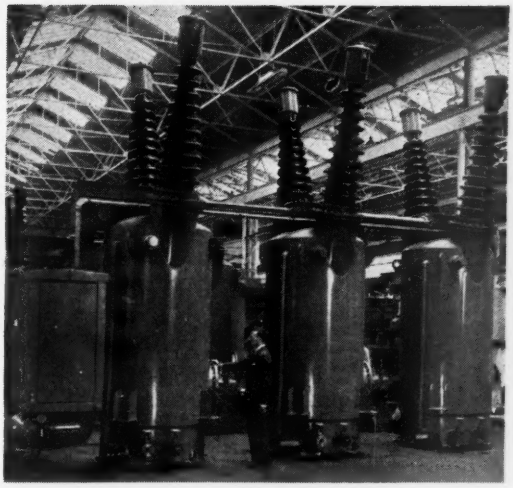
We express to the Acting Director and his Department our great regret that we unwittingly reproduced this matter from the *Nigeria Trade Journal.*

Educational

Particulars of the various courses at the Sir John Cass College, which include mathematics, solid and gaseous fuels, fuel technology, and radiochemistry and radioactivity, are obtainable from the secretary of the College, Jewry Street, London, E.C.3.

E.P.E.A. Team's European Visit

Last Tuesday a team from the Electrical Power Engineers' Association left London Airport to study some aspects of the electricity supply industry in Western Germany and France. The party, which is led by this year's E.P.E.A. president, Mr. John Parr-Morley, expects to be abroad for ten days. Other members of the team are Messrs. A. E. Hawkins, R. Johnson and J. E. Stanton. The journey is being made at the suggestion of the Trades Union Congress, through the European Productivity Agency. Electricity undertakings in Dusseldorf, Mannheim and Paris will be visited, where the team will check practices and methods in relation to productivity, joint consultation, labour relations, trade union organization, etc.



One of fourteen 132 kV, 3,500 MVA pneumatically operated type XOPR54 oil circuit-breakers ordered by the Electricity Commission of New South Wales from Ferguson Pailin, Ltd. They are intended for service at Lake Macquarie power station. Five have already been dispatched

New E.I.B.A. Offices

All those who are aware of the extremely cramped conditions under which the Electrical Industries Benevolent Association has been working for the last sixteen years will be pleased to know that at last it has succeeded in finding much larger premises on very reasonable terms. It will not be moving house until the end of the year; then it will be taking up quarters in Buckingham Palace Gardens, alongside Victoria Station.

Pumps for Argentina

Wilkinson Rubber Linatex, Ltd., Camberley, inform us that they have been successful in obtaining an order for 144 "Linatex" rubber lined centrifugal pumps for Argentina in the face of international competition. Negotiations were conducted with the Instituto Argentine de Promocion del Intercambio. The pumps will be used by the Argentine mining industry for handling abrasive slurries.

Fluorescent Lamp Activity

Scemco, Ltd., 6, Soho Street, London, W.1, informs us that its fluorescent lamp division is being moved into larger premises in the New Year which will enable it to increase production. The company has embarked upon a fluorescent lamp campaign among wholesale and retail electrical traders.

Trade Announcements

As from 1st October the address of **Porter Electrical Products, Ltd.,** will be 2, North Park Road, Harrogate, Yorks (telephone: Harrogate 3853; telegrams: "Portaway, Harrogate").

Arising from the merger of **Hordern-Richmond, Ltd.,** with **Permali, Ltd.,** last year, new Manchester premises for both companies have now been opened at Third Floor, B Block, 89, Oxford Street, Manchester, 1. The Northern office of the newly formed company, Hydulignum-Jabroc (Tools), Ltd., is at the same address.

TRADE MARK APPLICATIONS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 30th September:—

EDISON. No. 723,012, Class 9. Sound recording and reproducing apparatus and sound recording media for use with such apparatus.—Thomas A. Edison, Inc., New Jersey, U.S.A. Address for service: c/o Marks & Clerk, 57/58, Lincoln's Inn Fields, London, W.C.2.

PYE-REX. No. B738,612, Class 9. Radio apparatus and parts; gramophone pick-ups, microphones, amplifiers and loudspeakers; television apparatus and parts; electric oscillation generators; and electric batteries and accumulators.—Pye, Ltd., Radio Works, St. Andrews Road, Cambridge.

ELTRAK. No. 740,295, Class 9. Electrical heating elements. — Eltra Kommanditgesellschaft Leicht & Trambauer, Büchnerweg, Germany. Address for service: c/o W. P. Thompson & Co., 12, Church Street, Liverpool, 1.

CONSTELLATION. No. 740,736, Class 9. Electrically operated suction cleaners and parts.—Hoover, Ltd., Perivale, Greenford, Midddlesex.

LEWBEN. No. 742,160, Class 9. Insulated, fuse and resistance wire.—London Electric Wire Co. & Smiths, Ltd., 24, Queen Anne's Gate, Westminster, S.W.1.

SONIXGRAM. No. 742,935, Class 9. Radio, telephonic, television and telegraph instruments, sound recording and producing instruments, and parts.—Armstrong Television & Wireless Co., Ltd., 25/27, Oxford Street, London, W.1.

ULTRAFLEX. No. B738,892, Class 17. Flexible hose pipes not wholly or principally of metal.—Hoover, Ltd., Perivale, Greenford, Middlesex.

Public Lighting Engineers

ANNUAL CONFERENCE AT FOLKESTONE

Mr. J. M. Waldram, president, Association of Public Lighting Engineers

ON Tuesday last the annual conference of the Association of Public Lighting Engineers began at Folkestone; it closes to-day (Friday). As usual an exhibition of lighting fittings and equipment has been arranged and a review of this appears on a later page.

This year's president is Mr. J. M. Waldram, B.Sc., A.C.G.I., A.M.I.E.E., F.Inst.P., F.I.E.S., senior research illuminating engineer with the General Electric Co., Ltd. In his presidential address Mr. Waldram outlined the organization behind public lighting, showing the many contributions to public lighting by bodies and individuals outside the realm of the public lighting engineer proper. He thought that the Association's election as its president of someone from the manufacturing side was an acknowledgment that the job of public lighting involved a large team of people supporting the lighting engineer.

He went on to say that our roads were designed for pack-horses and slow wagons and were inadequate for modern fast traffic, yet we were turning out not only more cars but much faster cars. The cause of traffic accidents was traffic; the more we had, the faster it went, and the more accidents there would be, whatever the condition of the roads or the lighting. To-day the road and traffic problem was a dilemma in that if we succeeded in making the traffic expeditious it would be less safe and if we made it safe it would be less expeditious.

To the solution of this great problem public lighting engineers had a contribution to make; but only a contribution, because lighting would be effective only so far as it was part of a well-considered and thorough plan of our roads as a whole. Bad lighting might make a good road dangerous or slow, but good lighting could not make a bad road good.

In an endeavour to depict the "size of the job" Mr. Waldram said that the public lighting engineers in this country had about 20,000 miles of traffic route and "other roads" to light, representing a capital expenditure of about £50 million and the employment of about 10,000 men. He indicated both by description and diagram a typical team led by the public lighting engineer of a large municipality with its many interconnections between, to take only a few examples, the public lighting engineer and the manufacturer, the manufacturer and research, research and the British Standards Institution, the B.S.I. and the electricity supply authorities, the supply authorities and the lighting engineer, the lighting engineer and the local government authority. The president stressed that although the Ministry of Transport had power to make grants towards the cost of lighting on trunk roads, the initiative for any lighting scheme for such roads still rested with the local authority.

In dealing with practice and design he drew special attention to the two Codes of Practice which had after a long delay been prepared by a joint committee of the B.S.I. and the Institution of Electrical Engineers. They were two workable and agreed documents, couched in practical terms, which were the public lighting engineer's main design tools.

In calling for up-to-date theory to support practice, Mr. Waldram referred to the excellent work of such bodies as the National Physical Laboratory and the Road Research Laboratory, saying that the latter had picked up the threads which the industrial laboratories had had to drop when the war began, and it had carried on the work with vigour.

The president later demonstrated the important part played by the supply authorities in the development of public lighting. In some respects every public lighting point was from the Electricity Boards' point of view a separate consumer. A Board undertook to supply energy to the thousands of lanterns scattered over the area of a city, and was responsible for the connection to the mains at each column and in some cases participated in the control of sections of street lighting to the extent of providing pilot cables in its mains for central control.

Finally, Mr. Waldram showed the contribution of the lighting equipment manufacturer to public lighting. The essentials of a street lantern ("Optikon") consisted of a lamp and some refracting or reflecting equipment—all small, light and inexpensive. Yet the ancillary equipment and parts needed to hold those essentials together, protect them from weather, supply them with energy, apply the necessary restraints and adjustments to the energy, turn it on and off at proper times, and support the whole affair safely in the right position, might weigh up to half a ton, cost a great deal and involve many manufacturers and trades.

SECONDARY ROAD LIGHTING

The lighting of roads other than traffic routes was the subject of a paper by Dr. J. W. T. Walsh. Such roads had Group B installations for which recommendations had been submitted to the Minister of Transport by a Departmental Committee as the second part of a Code of Practice. Part 1 of the Code, relating to Group A installations suitable for traffic routes, was issued three years ago by the Institution of Electrical Engineers and the British Standards Institution.

Group B, unlike Group A lighting, could not always be adequate for car drivers, as it was primarily concerned with the needs of pedestrians and residents, illumination of footways and kerbs being the first consideration. It was divided into two classes, B_1 and B_2, according to the lighting most suitable for each case rather than to the type of road; the chief differences between the two were the distance between the building faces on opposite sides of the road in relation to the width of the carriageway and the effect of any trees. The range of luminous flux covered by Group B lay between 600 and 2,500 lumens per 100ft of roadway. The appropriate allowances were determined for B_1 by the amount of traffic and the width of carriageway and for B_2 by the width of thoroughfare including carriageway, footways and verges.

Group B_1 installations were similar to those in Group A, but with lower mounting heights (15ft with tolerances of 1ft upward and 2ft downward) and smaller amounts of luminous flux, especially for narrow carriageways; spacing

was still normally 100 to 120ft. Light distribution was invariably of the non-cut-off type and axial or very slightly non-axial in plan for carriageways not more than 20ft wide. Above that width the brightness level towards the centre of the road would become inadequate for traffic, implying the need for a Group A scheme.

On wide residential roads and housing estates typically suitable for B_2, a light distribution markedly asymmetrical in plan was not recommended, since the light was required towards the centre and sides of the road as well as up and down it.

For the avoidance of glare the limit of the rates of maximum intensity of the lantern in any direction to the average intensity below the horizontal was less than for Group A. With Group B lighting the lower general level of brightness necessitated an absolute ratio limit of 4, 3 being the desirable value instead of 6 for non-axial and 5 for axial distributions with 5 as the preferable maximum specified for Group A.

Requirements for the maintenance of efficiency (having regard to reasonable cost) remained as in Part 1. That is, tests during service should show not less than 60 per cent and preferably 70 per cent of the figures recorded when the installation was first put into commission.

ROLE OF LOCAL AUTHORITIES

Local authority aspects were dealt with by Messrs. G. Berry and W. H. Shaw (Coventry) who stated that the financial resources of 75 per cent of the 3,933 lighting authorities in Great Britain were insufficient to provide the standard of public lighting that was becoming increasingly necessary to safety. During the past ten years an expenditure of £1·7 million on lighting trunk roads had been authorized. The Minister of Transport contributed up to 50 per cent of maintenance costs, which reached £75,000 in the current year. In the same period £15 million had been spent on lighting non-trunk roads.

A pilot survey by the Institution of Municipal Engineers showed that 345 local authorities with an aggregate population of 22 million were spending yearly £5 million on maintaining 830,000 electric and gas lamps on 25,000 miles of highways; 53 per cent of the total was electric, but on trunk roads the proportion was now 62·7 per cent and would be 100 per cent for all new work.

The first choice for main roads covered by this survey was sodium-discharge lamps closely followed by mercury-discharge lamps, while for Group B installations (side streets) more than half the authorities intended to continue to employ tungsten-filament lamps. New lighting schemes in 94·5 per cent of the cases considered were being designed in accordance with the Code of Practice for traffic routes (Group A) and the Departmental Committee's recommendations for Group B installations. Costs of maintenance and energy per lamp averaged £5 18s; electricity accounted for £2 18s, and gas £3 10s.

A recent estimate for the whole of Great Britain (Tanner and Harris) gave 1·5 million existing street lamps costing £12 million a year, including loan charges; to bring these up to present-day standards would cost £5 million a year. Annual capital and running charges of Group A lighting (8,000 miles) were taken at £3,000 and £500 per mile and of Group B lighting (25,000 miles) £2,000 and £320, the capital being written off in 15 to 20 years. A reduction by 20 per cent of the 5,700 night accidents (involving 7,400 casualties) in 1952 at an average cost of £550 each would have saved £3 million.

The authors advocated the appointment of regional committees, composed of members of lighting authorities in the area, as planning and co-ordinating bodies, leaving day-to-day work to the local authorities. They also submitted that the present Ministerial lighting grant should be increased from 50 to 100 per cent.

The price charged by the Area Electricity Boards (1953-54) varied from 1·137 to 1·883d/kWh, the average being 1·393d, compared with 1·146d for industry and 1·393d for all purposes. Half of the street lamps were extinguished at 11 p.m., indicating the need for more favourable tariffs.

Reference was made to the possibilities of v.h.f. radio for street lighting control, which at present was not possible, as the Postmaster General did not allocate frequencies for communication between fixed points.

TREES AND LIGHTING

In opening their paper on " The Lighting of Tree-Lined Roads " the authors (Messrs. H. M. Ferguson, A.M.I.E.E., and W. R. Stevens, B.Sc., M.I.E.E., F.I.E.S., G.E.C. Research Laboratories) said that a street lighting engineer faced with the problem of road lighting from lanterns in a tangled thicket of foliage might well be pardoned for wanting all trees banned from urban areas. However, accepting the grace and dignity of trees they went on to give a workmanlike account of how to tackle the job.

Lanterns could be placed in four main positions: above, below or level with the tree foliage, or over the road between the lines of trees. Conditions were also quite different on Class " A " roads from those on Class " B " roads. On the former, traffic had to be able to travel at reasonable speed without headlights. Heavy shadows were particularly objectionable and a mounting height of about 25ft was needed. The most frequent solutions were those of mounting the lanterns on span wires or as far out from the kerb as a practicable bracket arm would permit. Centrally mounted true cut-off lanterns could give something of a tunnel effect, which was not attractive.

The lighting of Class " B " roads was dealt with in rather more detail. Here the requirements to be met by the installation were taken as the safety and convenience of pedestrians; the safety of property; a pleasant appearance to the area; and the convenience of motorists, in that order. Mounting heights between 11 and 15 ft with spacings of the order of 120ft were usual and light distribution was modified compared with main roads because there was no complex preferential reflection typical of traffic-polished roads.

A series of experiments on a typical North London suburban side street were described in considerable detail by the authors and an account was given of the evolution of an experimental lantern for the purpose. This was designed to produce a suitable light distribution with 150 W pearl tungsten lamps, and consisted of two modified dome refractors mounted mouth to mouth, and a conical " hat," partly translucent, to emit some light upwards on to the trees, and partly opaque white, to reflect down near the foot of the post. The lanterns were arranged for post-top mounting. A first test indicated too much glare at the points of maximum intensity and a dark region across the road at each lantern position, otherwise the amount of light on houses and gardens was adequate.

Normally, lantern performance was judged by examining the principal vertical and conical distributions, but it became clear that for this class of work a better appraisal could be made from the distribution of intensity in great circles which cut the road surface and buildings in straight lines parallel to the kerb.

After modifications to increase the downward light and restrict the light emitted at high angles a final test was made at which observers thought the performance to be as good as any lighting installation they had seen in tree-lined side streets with similar lamps.

The conclusions reached were that the general form of light distribution should have four maxima each "toed" away from the axial direction by some 25 deg and with the maximum intensities occuring at between 70 deg and 75 deg to the downward vertical. The optimum mounting height depended on the trees but should not be more than 15ft, and a satisfactory spacing was up to 120ft staggered. The minimum light output recommended was 750 lumens per 100ft linear.

CENTRALIZED CONTROL

Introducing his subject of "The Centralized Control of Street Lighting" Mr. J. F. Mackenzie said that most lighting points were controlled by individual time switches, and of most of the remainder control was by means of central systems or photo-electric cell control, with a small residue of hand-switched points.

The principal advantage of centralized control was its flexibility which enabled extensive systems to be controlled from a central desk in accordance with varying conditions. At the central point choice of signal initiation was from manual, photo-electric or time-switch control. The choice of the actual method of remote control was governed by site conditions, costs, operational demands and facilities, and this permitted the existence of many different systems. Control could be from each substation supplying lamps or from one central point of a city.

Among the systems available were fifth-wire control using an extra wire in the usual four-core cable. No extra laying costs were involved in a new installation, but as this was a comparatively rare occurrence it was often not an economic system. Similar considerations applied to the use of a pilot wire control. Several types of control using superimposed signals were available. In these the cost of pilots or extra wires was avoided but the terminal equipment was more expensive. Signals could be superimposed on the l.v. or h.v. networks; in the former case injection took place at substations and restricted control of the circuits fed from each point. With h.v. superimposition, distribution network conditions played a more important part in design.

Either a.c. or d.c. signals could be used in different systems, the latter being applicable only to substations, as d.c. would not negotiate transformers. Of the a.c. systems the earliest form of ripple control injected a voice-frequency signal from an electronic generator of about 150 W capacity. This actuated a vibrating reed responding to a particular frequency and operating a mercury switch via a ratchet and pawl mechanism. This type was now superseded and no commercial centralized system now used frequency selection only.

In the "time-impulse" system two or three signals were transmitted for each switching operation. The first started a synchronous clock type motor in each local switching relay, this rotating a switch arm over a series of contacts at 1 r.p.m. The second signal performed the actual switching operation by being sent when the arm reached the contact connected with the circuit it was desired to operate, and locking the switch arm. About half-a-dozen systems based on this idea were commercially available, some including cold cathode valves for signal amplification.

Another popular system used a rhythm or pulse timing of a train of impulses. The responding relays had oscillating members critically adjusted to the rhythm of the control impulses. Only two moving parts per operation were involved in the relays, making the system attractive, and three commercial interpretations had been produced.

Assessment of the relative values of the different systems was difficult because of the wide variation in working conditions. Considerations of maintenance and amortization largely controlled a decision but there was a growing influence from the intangible benefits of reliability and the removal of anxieties over labour discontinuity from various causes.

Mr. Mackenzie concluded by referring to the possibilities of centralized control by radio. Developments in the electronic field had made this much more feasible although no commercial system was yet available. Radio control of a lighthouse had already been achieved. It was probable that the initial application of radio control would be to the central control of substation units.

International Contractors' Organization

Writing in the September *Electrical Contractor and Retailer*, Mr. S. L. M. Barlow (a past-president of the Electrical Contractors' Association) outlines the organization and purposes of the International Association of Electrical Contractors which has been formed by representatives of electrical contractors' organizations in Great Britain, France, Italy, Denmark and Switzerland.

Monsieur Comtet (France) has been elected president with Mr. Barlow and M. Dusserre (Switzerland) as vice-presidents and Mr. L. C. Penwill (director and secretary of the E.C.A.) as treasurer. It has been agreed that surveys on subjects of general interest should be undertaken and they have been classified under four headings: Economics (with M. Dusserre in charge), technical (M. Huguet, France), social (Mr. Repsdorph, Denmark) and information (M. Grandvoinet, France).

Many subjects are to be considered and information will be collated and where possible circulated. The subjects include such matters as wages and on-costs in various countries; methods of increasing production; experience in the use of thermoplastic conductors, insulated conductors sunk into walls without mechanical protection, and flexible metallic tubes; earthing practice; small circuit-breaker protection; standardization of apparatus; recommended intensity of illumination in various countries, etc.

Varying-Load Battery Charging

A complex storage battery engineering contract was recently completed by Nife Batteries, of Redditch, in the course of extensions to the C.E.A.'s Northampton power station.

The main 240 V station battery consists of 200 Nife steel alkaline cells with a capacity of 170 Ah. Besides supplying power for indicator lamps and emergency lighting circuits during a mains failure (a total load of 25 A for up to 5 hours) it supplies a continuous average load of 5 A imposed by boiler gauge lamps and other important indicators. As the continuous loading varies the charging equipment is arranged to compensate automatically for any change. The control system is based on voltage variation so that if the voltage falls in meeting an increased load, the rectifier output is correspondingly increased through the operation of a "Variac" transformer, driven by a motor and automatically controlled by voltage sensitive relays.

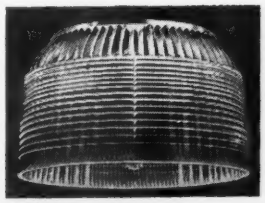
The load is normally connected across 185 cells but during quick charging it is automatically transferred to 155 cells so that no excess voltage is applied to the indicator lamps. Should there be a mains failure an automatic contactor brings the full 200 cells into operation. Provision is made for remote indication in the event of a rectifier failure and a three-phase circuit-breaker is fitted to disconnect the mains supply if one phase should fail.

An additional switchgear battery of 92 Nife LR27 cells, capacity 275 Ah, has been erected in the separate room housing the existing steel-alkaline battery of 260 Ah capacity. Both are now supplied by new automatic charging equipment similar to that provided for the main station battery.

Public Lighting Exhibition

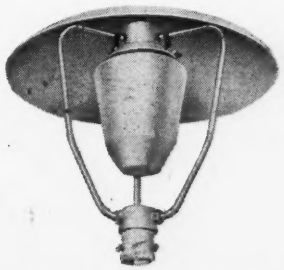
A SURVEY OF THE EQUIPMENT SHOWN

Franco Traffic 4/E street bollard

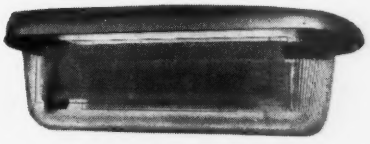


Holophane single-piece dome refractor for group "B" broad roads

"Golden Ray Mark III" lantern



Benjamin "Mushroom" fitting



Phosco "S.O. 140" enclosed prismatic lantern for 85/140 W sodium lamps

As usual a highlight of the annual conference of the Association of Public Lighting Engineers is the exhibition of public lighting equipment. There are about 40 exhibitors this year and the following classified survey has been drawn up from descriptive notes sent to us by exhibitors.

High efficiency of lighting parts is the keynote of the exhibits of Philips Electrical, Ltd., and they include a completely new and revolutionary development, the "Bamboo" discharge tube. This is designed to maintain high efficiency by stabilizing the distribution of metallic sodium along the length of the tube. This means that the light output will not be affected by the lamp position or by vibration so long as the lamp is operated within the limits laid down. New colour corrected mercury fluorescent lamps are also included in this exhibit and the 250 W lamp is physically interchangeable with standard MA/V lamps without the necessity for alteration to the lampholder and control gear.

Fittings exhibited by the Engineering & Lighting Equipment Co., Ltd., include lanterns for use with sodium, mercury and tungsten filament lamps which may also be classified as high efficiency. The totally-enclosed "Golden Ray Mark III" lanterns for use with 45/60 W and 85/140 W sodium lamps combine high optical performance with good design and mechanical construction.

Among the traffic control signal equipment is the "Autoflex" vehicle-actuated system shown by the Siemens & General Electric Railway Signal Co., Ltd. The display includes a vehicle detector, controller and two-aspect signal, the controller being fitted with "Perspex" panels to enable its operation to be observed.

Illuminated street bollards are shown by Franco Traffic Signs, Ltd., and the company's display includes the "Exlite" Type III external lighting fitting for traffic signs which is streamlined and most attractive in appearance. By bringing the lamps and the large lamp aperture into the appropriate position in relation to the face of the sign, the entire area is brightly and evenly illuminated.

An interesting range of "matching" bollards constitutes a part of the exhibit by Bergo, Ltd. The main feature is the company's new A1 bollard which is strong and simple in construction whilst being exceptionally easy to maintain.

The "Smoothline" guardpost displayed by Gowshall, Ltd., has been made possible by the revision of the Ministry of Transport and Civil Aviation bollard specification which now allows a body width of 13in. Front, sides, back and top are co-ordinated and the lenses above and below the front (top) panel are fitted as part of the chassis.

A working demonstration of a recently introduced pedestrian-actuated traffic signal is one of the exhibits of the Automatic Telephone & Electric Co., Ltd. The signals are designed to end unnecessary hold-ups which at present hamper both pedestrians and motorists at many busy zebra crossings.

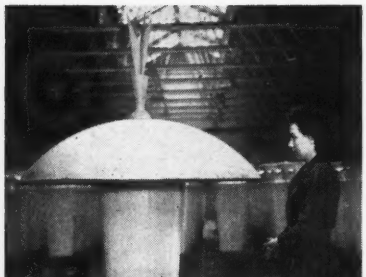
Holophane, Ltd., have introduced the Type B1 dome and bowl refractors designed for application in narrow and medium width group "B" roads. There are the refractor No. 2/4116-B1 which is a single-piece dome and model No. 2/4125-B1 single-piece bowl. There are also Type B2 dome and bowl refractors for residential roads with wide grass verges and deep gardens. The refractor in this case is No. 2/4116-B2 single-piece dome and No. 2/4125-B2 single-piece bowl. The new Holophane refractors have the same fixing arrangements and identical centre positions and are therefore interchangeable in existing lanterns. The "Lumifractor" is a new fitting which presents a simplified and inexpensive application of the popular single-piece dome refractor for group "B" installations.

Phosco, Ltd., show totally-enclosed lanterns for use with sodium lamps for both group "A" and group "B" lighting. The S.O.140 lantern for group "A" lighting is totally enclosed with a special "Perspex" bowl and prismatic panels.

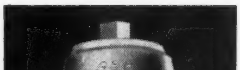
Light Control System

Taking pride of place in the exhibits of Thorn Electrical Industries, Ltd., is the "Alpha One" sodium lantern which is designed for main highway and motor road illumination. The unique "Opticell" and special light control system employed here are claimed to achieve new standards in efficiency and reduce maintenance costs. The "Alpha Two" is a new fluorescent lantern for group "A" lighting in town centres and on main highways where fluorescent lighting is required. This lantern also employs the light control system mentioned above and it has specially designed weatherproof construction which ensures long maintenance-free periods.

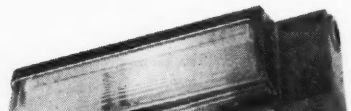
The new "Mushroom" lighting fitting displayed by the



Revo "Kuwait" lantern for vertical fluorescent lighting



G.E.C. "Plastifractor"



Falk, Stadelmann "Fulmar" plastic fitting

Benjamin Electric, Ltd., is described as particularly suitable for public gardens and parks, promenades, drives, forecourts of public buildings, boulevards, carnivals, etc. It is a pole type mounted unit and the actual exhibit is a prototype which has been developed from earlier models as at present installed in the gardens on the South Bank Festival site.

For class "A" lighting the "Lancaster" and "Tring" fittings for use with 250/400 W mercury lamps and the "Trent" lantern for 300/500 W tungsten filament lamps are Engineering & Lighting Equipment exhibits. For class "B" lighting this company has also on show the "Welwyn," "Ware," "Baldock" and "Letchworth" lanterns, as well as the "Universal 100" lantern which is becoming increasingly popular, no doubt because of its inexpensiveness.

A development in this field by Holophane, Ltd., is a fluorescent lantern for group "A" installations. The "Acorn" lantern accommodates a 400 W MBF/U lamp and combines efficient light distribution with good colour rendering.

Representative of fluorescent lighting are three new G.E.C. multi-lamp hot cathode fluorescent lanterns. They are the "Three-Eighty," the "Vertical Four-Eighty," and the "Four-Forty." The "Three-Eighty" has a new body design incorporating concealed hinges and catches which hold the one-piece "Perspex" enclosure. The "Vertical Four-Eighty" fluorescent lantern is ideal for main thoroughfares and city squares. It houses four 5ft 80 W tubes. The "Four-Forty" lantern is intended primarily for side road lighting and it accommodates four 4ft 40 W tubes.

Access rotary "Giraffe"

A further exhibit in the field of fluorescent lighting is the F240V lantern by Phosco, Ltd. It is a vertical unit in the form of a truncated cone. The whole lantern, with the exception of the spigot cap and centre support which carries the control gear, is made of "Perspex."

Another fluorescent lamp development, also with the plastics fitting feature, is the "Kuwait" lantern of the Revo Electric Co., Ltd. The unit consists of a tapered opalescent "Perspex" cylinder 36in long and 18in in diameter at the top and carrying eight 30 W fluorescent lamps. The cylinder is surmounted by a 4ft 3in diameter dome accommodating eight 150 W tungsten lamps, thus affording an excellent example of mixed lighting.

The "Kuwait" lantern of the Siemens Bros. group constitutes a new departure in street lighting design inasmuch as the lantern has a swan neck which blends with the bowl top and ensures a sweeping unbroken line. Two or three 5ft 80 W fluorescent tubular lamps with anti-corrosion reflectors are used. The "Perspex" bowl is designed to assist the optical characteristics and a combined "Sorbo" rubber and asbestos gasket completes the sealing.

Another Siemens exhibit is the "Coventry" lantern which is a double version of the "Kuwait"; in construction it is virtually the assembly of two lanterns mounted on a single head casting. This fitting is designed primarily for use on road islands between dual carriageways.

Lantern for Wall Fixing

Wall fixing of lighting fittings is a necessity in many narrow streets and in this connection Holophane, Ltd., is showing the "Muralux" side-of-house lantern which has a two-way non-axial distribution. The lantern is effectively sealed and a watershed lip ensures weatherproof fitting.

The use of plastic materials in the construction of lighting fittings is presented at the exhibition by the General Electric Co., Ltd., in the first of a new series of "Plastifractor" bowls. These are injection moulded in "Diakon," a moulding powder chemically identical with "Perspex." The bowl has a non-axial asymmetric distribution suitable for side street lighting.

Operation of lighting fittings at low temperature or comparatively low temperature is of course important and we gather from the Falk, Stadelmann exhibits that plastic units are a help in this direction. The "Fulmar" range of lanterns for sodium lamps which operate at lower temperatures allow the use of machined "Perspex" refractor plates which are rather more efficient than the equivalent glass refractors and are almost indestructible. "Fulmar" sodium lanterns are available in open and enclosed types.

Another insight into what is being done in the way of plastic lighting fittings is the display by Imperial Chemical Industries, Ltd. This includes polymethyl methacrylate products, and their application to street lighting. There is here also a demonstration of the fabrication by injection moulding of "Diakon" into lanterns. Such physical properties as heat resistance, weathering, mechanical strength and optical abilities are stressed. A display of lanterns emphasizes the overseas market for "Perspex" street lighting. The weather resistance and dimensional suitability of

the properties of "Diakon" are of such a high order that the mouldings do not dull, craze or warp.

"Perspex" industrial fittings are also included in the exhibits of Engineering & Lighting Equipment.

Filament lamps for public lighting are still favoured by many authorities. On the stand of Falk, Stadelmann & Co., Ltd., the "Albemarle," which has a cast-iron hood, is a good example of this type of fitting. Falk, Stadelmann exhibit enclosed lanterns which are gasketed to exclude water and dust. Two or four stainless steel clips, according to the size and type of the lantern, ensure an efficient seal throughout the complete length of the gasket.

Maintenance Towers

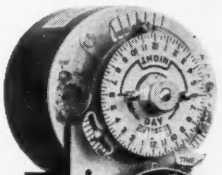
Accessibility for maintenance purposes, particularly in the case of high mountings, is important. A high level maintenance tower is shown by Beresford Atkinson, Ltd. It has a platform height of 22ft 6in in the case of one model and 28ft in the case of a second. The tower is mounted on a tricycle chassis designed for vehicle towage. It has rubber tyred wheels and a well-sprung rear axle. The front wheel is retractable, allowing for manual manipulation when it is disconnected from the towing vehicle.

Another tower, displayed by Tubewrights, Ltd., has been designed to meet the demand for an economical structure to carry varying arrangements of floodlamps for high-level illumination of railway sidings, stockyards, etc. The tower is available in a range of heights from 30ft to 60ft and it can be supplied with a round, rectangular or octagonal platform. There is an access ladder with safety loops and stringers. The tower is made in units of triangular all-welded tubular steel which are bolted together on the site.

Another public lighting maintenance tower is the rotary "Giraffe" shown by Access Equipment, Ltd. The working platform is horizontally operated and provides an overhang and upward lift. It will rotate through 360 deg and the platform and stairway are always parallel to the ground regardless of the boom angle. The equipment is mounted on a lorry and seems to be a most economical way of servicing overhead equipment.

Another maintenance equipment is the "Eclipse" telescopic tower ladder truck shown by R. A. Lister & Co., Ltd. It combines low first cost with low running and maintenance charges, mobility and manœuvrability. The Lister auto-truck power and steering unit turns through an unlimited lock in the chassis ring, enabling the truck to turn in less than its own length.

Above: Simon lorry-mounted maintenance tower



Left: Venner "TJSSP" time switch

Another lorry-mounted maintenance tower is the Simon hydraulic platform exhibited by Simon Hydraulic Machinery.

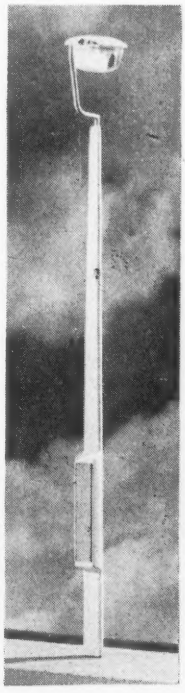
A further contribution to maintenance by way of tower wagon equipment is the "Eagle" wagon displayed by Vauxhall Motors, Ltd. It is a telescopic wagon in four stages which is mounted on a Bedford three-ton chassis/cab.

A street lighting meter shown by Megatron, Ltd., has been developed in conjunction with the research laboratories of the General Electric Co., Ltd. It incorporates a 6in diameter selenium cell in a cosine-corrected mount connected through a 9ft length of armoured p.v.c. covered twin cable to a robust self-contained taut suspension light-spot galvanometer. Four ranges of foot-candles are catered for, namely 0-0·1, 0-0·5, 0-2·5 and 0-5.

For gas street lighting there is an electrically-wound synchronous, gun-fire gas controller with spring reserve shown by the Automatic Lighting Controlling Co., Ltd. This has switching capacities from 20 A s.p. and 50 A t.p. air-break and a hermetically sealed case and mercury-to-metal contacts.

Time Switches

Among the time switches in the exhibition is the Type "Y" switch of the Horstmann Gear Co., Ltd. It is a small compact unit which is electrically wound and incorporates a spring reserve. It can be readily fitted into the modern streamlined lamp column where space is limited and being of the plug-in type the switch and clock movement may be removed without disturbing the wiring. The movement is fitted into a dustproof case but the complete time switch can be supplied with or without an outer



One of the new Spun Concrete columns

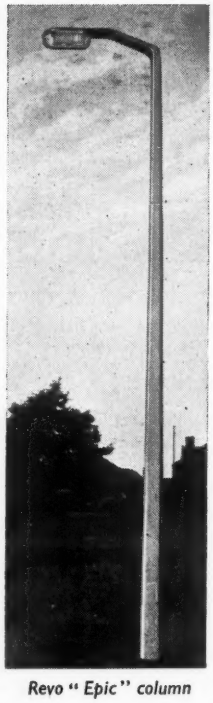
Concrete Utilities' "Highway" column

weatherproof box as desired by the customer.

Another exhibitor of time switches is Sangamo Weston, Ltd., which shows its models "S.S.C.," "S.S.C.R.," "S.S.F.B." and "S.S.F.C." The Type "TJSSP" time switch of Venner, Ltd., carries a nine-hour spring reserve of power. The design has recently been improved by the addition of a small 6 minute dial giving dual indication of clock operation. Provision is also now made for hand winding. The "MSDC" time switch will switch on all the tubes in each lantern at sunset, switch off a proportion of them at midnight and leave the remainder illuminated until sunrise, thus ensuring economy in running costs.

A display by Bright, Son & Co. (Clerkenwell), Ltd., illustrates their work as repairers of all types of time switches. Their service to public lighting authorities includes a new delivery and collection scheme.

Several concerns show columns for the mounting of lighting fittings. Among them is Spun Concrete, Ltd., which has two new columns, one for group "A" and one for group "B" lighting. The dense, reinforced, impermeable concrete used in their construction is produced by the centrifugal spinning process. This provides great strength and has permitted tapering, slender lines to overcome objections to bulky, ugly columns.



Revo "Epic" column

The display by the Stanton Ironworks Co., Ltd., includes twelve spun concrete columns, five for group "A" and seven for group "B" lighting. All the group "A" columns, whether pre-stressed or normally reinforced, are acceptable to the Ministry of Transport for use on trunk roads.

Concrete Utilities, Ltd., has introduced several new designs for group "A" and "B" lighting. The "Avenue 3DNN" column with the new "Arc III" range of brackets is also shown and it is stated that moulds have been sent overseas to permit the use of this column in other parts of the world. The latest model of this combined column and bracket is the "Highway X" which although it is probably a little more expensive, is likely to prove more popular.

Other interesting street lighting columns are shown by Stewarts & Lloyds, Ltd. These include twelve of the company's standard designs suitable for use on either group "A" roads with 25ft mountings or group "B" roads with 15ft mountings. Most of the columns have been approved by the Council of Industrial Design and they combine strength with grace and simplicity.

One of the exhibits of Poles, Ltd., is a column for 25ft mounting which is fitted with a Siemens fluorescent lantern of unique design. The smoothly tapering shape of this column with its flush fitting door blends into the lantern, the complete unit being very attractive.

The Revo exhibits also include a new "Epic" column with a special slender base particularly appropriate for narrow thoroughfares.

Of the comprehensive display of columns by the North Midland Engineering Co., Ltd., particular mention may be made of columns Nos. 527 and 528. These are tubular steel columns for group "B" roads and have been approved by the Council of Industrial Design. In each case the column and lantern has been designed as a complete unit and the height of the light source is 15ft.

Powder Metallurgy

A 312-page report has just been published at £1 by the Organization for European Economic Co-operation, which summarizes the findings of Technical Assistance Mission No. 141 which, consisting of 28 members from Belgium, Denmark, France, Germany, Italy, the Netherlands and the United Kingdom, spent five weeks in 1953 visiting and inspecting manufacturing plants, university and other research establishments in the United States. The Mission was organized into four groups, and the field of powder metallurgy was divided into the following categories—electrical and magnetic materials; hard metals (tungsten, cobalt, carbides); refractory materials (cermets, titanium, zirconium); and engineering and structural parts.

In general the Mission found that the enormous internal market, together with the high cost of labour, enabled techniques and expensive equipment to be employed which would be uneconomic in the smaller, more restricted, European markets. Thus each of nine large American companies producing hard metals produced more than the entire industry in any of the European countries, whilst in the pressing of abrasive iron oxide powders in the production of ferrite magnets, expensive tungsten carbide dies were used, whereas in Europe cheaper, though more short-lived, hardened steel dies were common because of the smaller quantities involved. This is, however, an example of a practice which the Mission recommended should be re-examined.

In the field of magnetic and electrical materials production an important application was the production of small sintered metal magnets in Alnico V and VI, frequently orientated. Experimentally, permanent magnets were being made from fine iron powder of grain size 0·01 to 0·02 microns. Low loss ferrites were in great and expanding demand; ferrite permanent magnets were coming into importance as television focusing magnets, etc.: one of their greatest virtues was that they conserve strategic materials. Radio cores were made chiefly from carbonyl iron powder; other cheaper powders were also used. Molybdenum permalloy was used in decreasing quantities as the size of telephony cores was reduced.

Tungsten wire production did not differ fundamentally from that in Europe. Carbide production and utilization was on a vastly greater scale, due to the enormous productive capacity of American engineering industry, and is continually increasing. Ferrous and non-ferrous powder production plants were visited, also plants producing a wide variety of structural parts—notably bearings and small intricate parts in automobiles, refrigerators, business machines, etc.

The report will repay close study by anyone concerned with powder metallurgy, also by those who might possibly utilize its products: they would obtain from this report a valuable bird's-eye view of a rapidly expanding industry closely associated with the high American standard of living.

Coal by Road

Electricity (the C.E.A. journal) says that an experiment was started in July in bringing coal by road directly from pits in the East Midlands to the Hackney and West Ham power stations (London Division), each of which received 400 tons a week. The experiment, which has shown a saving in transport costs of about £200 a week, is to continue until October when it will be decided whether road-borne coal shall be a permanent institution.

NEW BOOKS

Electromagnetic Principles of the Dynamo. By Prof. E. B. Moullin, Fellow of King's College, Cambridge. Pp. 367; figs. 158. Oxford University Press, Amen House, London, E.C.4. Price 50s.

The scope and aim of this work are clearly outlined by the following quotation from the preface—"It should be understood that this is a purely academic book written for those who are using electromagnetic principles of the dynamo as a discipline for mental training: whether or not they are expecting to become builders of dynamos is quite irrelevant to its purpose." With this statement in mind the reader may be prepared for an academic work with little or no relation to practical engineering. It is true that the machine is used to provide a set of electromagnetic problems for the demonstration and exercise of fundamental principles but it is also clear that while posing these problems and discussing their solution the author has never lost sight of the purpose and requirements of the machine on which they are based.

Although the book is primarily intended for students of electromagnetism the engineer will find that in many cases new light is thrown upon well accepted principles and some readjustment of existing ideas may result. Discussions of some apparent paradoxes are not so much digressions as philosophical exercises on the matter under consideration.

Commencing with a brief outline of the form of two-pole and of multipole machines the author considers the estimation of ampere-turns for the magnetic circuit in some detail and a numerical calculation is worked out for an actual machine. The effects of armature current are then discussed with the theory of brush shifting, interpoles and compensating windings and their influence upon the flux distribution.

Characteristic curves are derived for generators with different methods of excitation and also for the same machines used as motors. An interesting construction to allow for the effect of demagnetizing ampere-turns is included in this section. The chapter on efficiency and losses covers the torque equation and the prediction of losses from design data. The treatment of commutation involves an estimation of winding inductance and a further consideration of the action of interpoles.

Parallel operation of dynamos is analysed and sections are devoted to boosters and balancers as well as a short section on cross field machines. A full inquiry into the theory of these machines conducted on the same lines as the rest of the book would be very valuable but such a study would occupy another volume. Among the supplementary information appended at the end of the book is a Fourier analysis of the field form curve, the effect of breadth factor upon harmonics and a brief reference to a.c. machines.

A large number of examples with skeleton solutions are included and there can be no doubt that the student who works through these in conjunction with the relevant text will have gained not only a good understanding of the dynamo but a fuller grasp of electromagnetic principles generally.—J.A.C.

Magnetic Amplifiers. By H. F. Storm. Pp. 508; figs. 360. Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2. Price 108s.

This is a thorough work whose purpose, in the author's words, is to explain the fundamentals underlying operation of magnetic amplifiers and to illustrate their principal uses. The first twenty chapters are devoted to fundamentals, the remaining nine to mechanical construction, rectifier properties and qualitative descriptions of specific circuits.

An introduction is given to the theory of magnetism followed by chapters on magnetic materials and magnetic testing. A table of magnetic core material properties is included, but it might become more useful if a.c. magnetic properties, which are presented in Chapter 16, were included.

Treatment of magnetic amplifiers throughout the work is based on normalized or "per unit" quantities; this will be of great help to magnetic amplifier designers. The majority of the circuits discussed are of the "free second harmonic" full wave type with very low control circuit impedance. In Chapter 5, qualitative consideration is given to the problems of higher control circuit impedance and a second harmonic suppression index is defined. Half-cycle response magnetic amplifiers, which are assuming increasing importance, are only briefly mentioned (Chapters 19 and 27).

The effects of over-excitation (excitation sources capable of driving the cores well into saturation) are discussed clearly and thoroughly in Chapter 7. Considerable space is devoted to proving the well-known expressions relating to matching of a source to a resistive load. D.c. current transformers are considered in Chapter 8 and the relations between sensitivity, current transformer burden and excitation voltage are discussed. An a.c. current transformer whose zero point can be shifted by d.c. bias is also mentioned.

Transient response forms the subject of Chapter 10. Elementary Heaviside operators are employed; these should present no difficulty to the majority of readers. Deterioration of transient performance due to eddy currents and the apparent "dead time" for under-excited saturable reactors are referred to. Equivalent circuits, corresponding to vacuum tube feedback amplifiers with separate α and β circuits are suggested. Dynamic power gain is computed for several magnetic amplifier configurations, but no explicit reference is made to the concept of gain-bandwidth product.

Magnetic amplifiers with extrinsic feedback and analogies to rotating amplifiers are considered in Chapter 13, which also deals with Fitzgerald's work on feedback magnetic amplifiers. The useful "rotation of co-ordinates" method is employed to determine gain with extrinsic feedback. Electric or galvanic feedback, as recently described by Geiger, is mentioned and expressions for its effect on input impedance are developed.

Time constants are expressed in Chapter 16 in terms of core losses. This is useful in the design of large saturable reactors where core material properties are often given as losses per pound rather than by a statement of coercive force and remanence. In Chapter 19 the author refers to the difficulty of establishing a rigorous theory for magnetic amplifiers with suppressed even harmonics (high control circuit resistance). "Free wheeling" rectifiers, which improve the current gain of magnetic amplifiers feeding large time constant inductive loads are mentioned in Chapter 20.

Mechanical construction, winding and insulation problems are well covered in Chapter 21, which deals also with the effect of various core configurations on leakage reactance. Metal rectifiers, including modern high power germanium diodes, are described in Chapter 22; temperature effects and rectifier ageing are also mentioned.

Push-pull magnetic amplifiers of standard form are discussed in Chapter 26, which also describes phase sensitive detectors and simple transistor pre-amplifiers. The final chapter deals with ferro-resonant phenomena. The book concludes with an extensive bibliography.—G.M.E.

BOOKS RECEIVED

"So You're Going to a Meeting." By Sir Walter Puckey. Pp. 112. Published by Maxwell Love & Co.; obtainable from the Institution of Production Engineers, 10, Chesterfield Street, London, W.1. Price 5s (postage 4d). —An amusing and instructive dissertation upon the purposes, planning, results and other aspects of conferences.

Transistors and Other Crystal Valves. By T. R. Scott. Pp. 254; figs. 65. MacDonald & Evans, Ltd., 8, John Street, London, W.C.1. Price 45s.

Practical Electroacoustics. By M. Rettinger. Pp. 271; figs. Thames & Hudson, Ltd., 244, High Holborn, London, W.C.1. Price 63s.

Electrical Measurements and Measuring Instruments. By E. W. Golding. Pp. 913; figs. Sir Isaac Pitman & Sons, Ltd., 39, Parker Street, London, W.C.2. Price 40s.

Servomechanisms and Regulating System Design. Vol. II. By Chesnut and Mayer. Pp. 384; figs. Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2. Price 68s.

Planned Lighting

RECENT INSTALLATIONS EXEMPLIFYING MODERN PRACTICE

IT is now generally recognized that the best lighting installations are those in which the lighting engineer has combined with the architect and the consulting engineer in planning the installations. On the opposite page are illustrated examples in which this combination has been employed, and a brief description of the installations is given in the following notes.

One of the largest dimmer-controlled fluorescent colour-change lighting schemes in Britain has recently been installed in the main hall of the Norwich Industries Club. Suspended from the portal frames of the building are fibrous plaster lighting troughs, each containing three continuous runs of six 5ft 80 W "Atlas" tubes on either side of the frame. More than three hundred tubes in gold, blue, and pink are controlled by an electronic dimmer bank using twenty-one pairs of thyratron valves, housed in a room adjacent to the hall.

Each of the three colour groups can be controlled independently by hand until automatic control is required. There are two control panels, one on the bandstand and one on the balcony, each having in addition to the three colour controls, a five-position switch. In the fifth position, the whole installation is faded to full up, giving general white light. In the fourth position the three colours are brought into play, and in the third position the automatic colour change will operate, giving general change over the whole ceiling, which can be stopped at any colour desired. At the second position, the sections change colour in rotation along the ceiling, and in the first position the installation is faded down to nil. Each of the panels has a switch to enable it to take over control from the other as required.

The bandstand incorporates local lighting from incandescent fittings and a coloured background which can either be controlled independently of the main hall, or made to change colour in unison with it. The equipment was supplied by Thorn Electrical Industries, Ltd. The architects were Messrs. J. Owen Bond & Sons, and the electrical contractors, Messrs. G. S. Carey, Norwich.

Fluorescent lighting has recently been installed in a new luxury suite of offices in Devonshire House, Piccadilly. Some 90 5ft fittings with all-"Perspex" diffusers have been used to give approximately 20 lumens/sq ft on the working plane. The "Mazda" F1234 fittings used have one-piece "Perspex" diffusers which totally enclose the fluorescent lamps and control gear. The lighting was planned and installed under the direction of the architect, Mr. Thomas Mitchell, B.Sc., A.R.I.B.A.

Multi-Unit Fitting

Falk, Stadelmann & Co., Ltd., have recently completed a lighting installation at the Stratton School, Biggleswade, which demonstrates the advantages gained by the co-operation of architect and manufacturer. The main fitting is 23ft long and 9ft wide. It consists of sixteen composite units, each comprising a lower satin opal glass shade and an upper pale green metal reflector. These are mounted on satin and polished brass tubular rings and suspension tubes. The centre feature is balanced by two 9ft diameter matching fittings and by pale green "diabolo" brackets around the perimeter of the hall. The electrical installation was carried out by Messrs. H. A. Cawdell, Luton, and the architect in charge was Mr. H. Hartley, A.R.I.B.A.

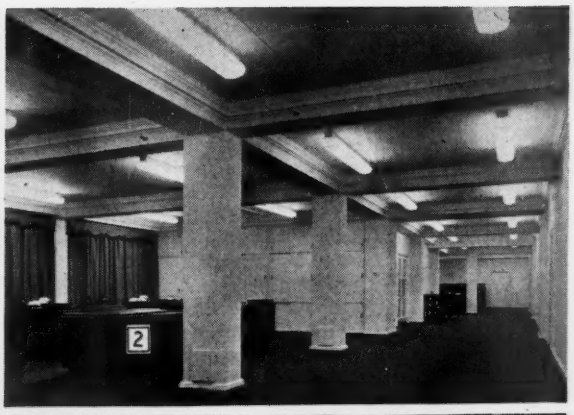
For the lighting in the new examination halls of Edinburgh University, tungsten light sources in recessed fittings provide the basis of various ceiling patterns. In one examination hall, for example, the light sources form the centres of 24 wide circular recesses set in an open lattice of straight diagonal mouldings. In another they are set in an undulating ceiling. In the art gallery room they are arranged in a false ceiling in two pairs of lines flanking six wide circular laylights. The laylights, which are covered by polystyrene louvres, admit natural light in the daytime. Artificial light is provided by four 150 W floodlights recessed into the walls of the laylight wells. In the daytime the walls, on which paintings are hung, are lit by daylight from obliquely arranged skylights. At night they are lit by a row of tungsten light sources mounted in the same plane as the skylights and focused on the walls. The recessed lighting fittings in all these rooms, as well as in the theatre in the basement, were designed by the General Electric Co., Ltd., so that they could be focused, serviced and have lamps replaced entirely from underneath. They consist of a "Gecoray" reflector in a casing covered by a heat-resisting sand-blasted glass dish which diffuses the light. The larger fittings house 300 W "Osram" lamps and the smaller fittings 200 W lamps. The architects for the new examination halls were Messrs. Rowand, Anderson, Kininmonth & Paul, the consulting engineers Messrs. Mitchell, Day & Lackie, and the electrical contractors William Allan Smith & Co., Ltd.

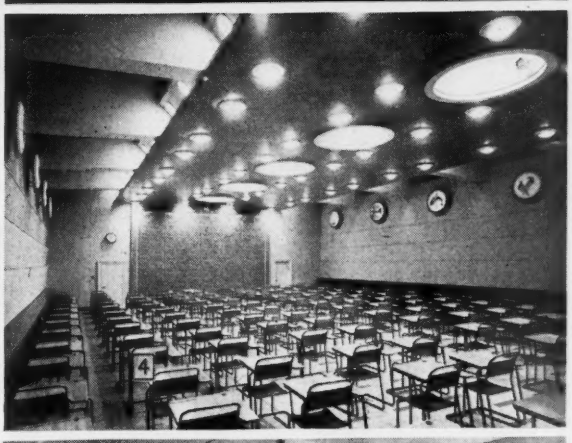
Food Handling

Good lighting is essential in the large areas of canteen kitchens as it not only facilitates work and safe handling, but leads to better hygiene. In the new canteen at the Scandinavia Mills of British Belting & Asbestos, Ltd., Cleckheaton, Yorks, the lighting fittings have been arranged with due regard to the canopies. Benjamin "Saaflux R.L.M." reflectors with diffusing "Visor" covers have been installed in the open area, each finished in "Crysteel" vitreous enamel. The areas below the glass canopies are illuminated by means of frosted well glass units, actually mounted within the canopies. The requirements of the sinks along the rear wall are catered for by additional "Benflux" reflectors.

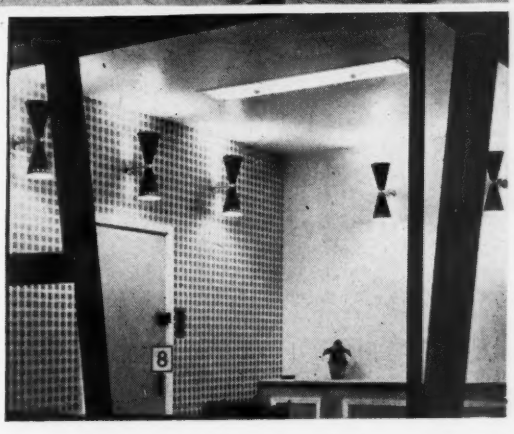
Colour rendering characteristics of interior lighting are of extreme importance in clothing shops. The ground floor of George A. Lavey & Co.'s new store at Swansea has a blending of "de luxe warm white" fluorescent tubes and tungsten filament lamps. The electrical installation was carried out by the Powis Electrical Co., Ltd., using Siemens electric lamps and spotlight fittings.

The first "Lumenated" ceiling to be installed in a ladies' fashion shop has just been completed at the Queen Street, Blackpool, premises of Jeanne Stuart (Blackpool), Ltd. It comprises a false ceiling of corrugated vinyl plastics erected below the fluorescent lamps, so that the entire ceiling area is evenly illuminated. The installation is in three main sections, the windows, shop and fitting rooms. The display lighting for each of the two windows comes from a "Lumenated" ceiling, one illuminated by three, and the other by two, 8ft 125 W fluorescent tubes, in a plenum depth of 2ft 6in. The total ceiling area for both windows is approximately 100 sq ft. The shop itself has





1. *Norwich Industries Club (Thorn)*
2. *Devonshire House, Piccadilly (B.T.H.)*
3. *Stratton School, Biggleswade (Falk, Stadelmann)*
4. *Examination Halls, Edinburgh University (G.E.C.)*
5. *Swansea store (Siemens)*
6. *Canteen, Cleckheaton (Benjamin)*
7. *Fashion shop, Blackpool (Lumenated Ceilings, Ltd.)*
8. *Car showroom, Belfast (Philips)*



a "Lumenated" ceiling totalling 200 sq ft which is lit by six 8ft 125 W and six 5ft 80 W fluorescent lamps. The plenum depth is 1ft 6in. Over the fitting rooms and rear part of the premises is a 288 sq ft ceiling with six 8ft 125 W and sixteen 5ft 80 W lamps in a plenum depth of 1ft. The lighting system (Lumenated Ceilings, Ltd.) was installed by the Marton Construction Co., Blackpool.

The Belfast branch of Philips Electrical, Ltd., has recently completed an extensive lighting scheme for the new service station of Leslie Porter, Ltd., at Nutt's Corner Airport, Belfast. This ultra-modern building stands within the airport perimeter and, so as to avoid any possible confusion with official signals from the control tower, the lighting had to be carefully planned. This stipulation applied, particularly, to the floodlighting of the forecourt. Here, three 140 W sodium lamps, without fittings, have been mounted in a trough built into the front of the canopy which covers the petrol pumps and air and water towers; this lighting is quite invisible from the air. The rear portion of the canopy is lit by two "Redhill" 140 W fittings completely recessed into the canopy behind cream louvre sections in an aluminium framework. Beyond the forecourt there is a car showroom where twelve "Weymouth" fittings with 150 W ring-type reflector spotlamps provide pleasing illumination, supplemented by five "Woking" double cone wall brackets mounted at 6ft 9in above ground level on the dark blue rear wall. Fluorescent lighting is also employed in other sections of the station. The electrical contractors were Thomas Crowe, Ltd., of Belfast.

Trades Union Congress

Further Notes on Southport Proceedings

AT the Trades Union Congress at Southport last week Sir Vincent Tewson introduced the General Council's report dealing with industrial disputes. In this the Council asked for power to intervene in an industrial dispute before and not after negotiations had broken down.

Sir Vincent said that the present system was day by day solving problems. Those which were not solved were only an infinitesimal fraction of the total. In the ultimate resort the difficulties of industrial relations could be solved only in the conference room or on the workshop floor. Our standard of living depended on industrial stability. There could not be a dispute in one industry without affecting others. Had there been a prolongation of the recent docks dispute, it would have had a paralysing effect on industry. When a dispute came to the General Council it had usually got to such a stage that it was extremely difficult to handle.

Mr. Frank Foulkes, general president, Electrical Trades Union, moved the reference back of the proposal. He argued that the change in rule the Council was asking for would make it impossible for a trade union to fight a dispute to a finish. It would give an employer the right to use the General Council in intervention. If a union could not accept a settlement between the Council and the employers, public opinion would be influenced against it, and it would be at a great disadvantage in subsequent negotiations.

Mr. J. Campbell, National Union of Railwaymen, supported the reference back but the motion was defeated. The amended rule now reads:—

"If there is a likelihood of negotiations breaking down and creating a situation in which other bodies of workpeople affiliated to Congress might be involved in a stoppage of work or have their wages, hours and conditions of employment imperilled the General Council may take the initiative by calling representatives of the organization into consultation and use its influence to effect a just settlement of the difference."

A composite motion on technological advance carried an amendment from the National Union of Public Employees which was the cause of considerable debate.

The motion expressed the belief that Great Britain stood on the threshold of technological advances, including electronic and automatic processes which would present the trade union movement with new opportunities for securing higher living standards for its members and the community. It was foreseen, however, that these opportunities would be attended by new and complex social and economic problems which could only be solved by a greater measure of workers' participation in industry through joint consultation.

The National Union of Public Employees wanted the "progressive transfer of private undertakings to social ownership" and plans prepared for the extension of social ownership to appropriate industries.

Opposing the amendment on behalf of the General Council, Mr. J. Crawford said the difficulty of technological advance was that so little was known about the subject. Much of it was speculation. Congress rejected the amendment by 3,339,000 votes to 4,465,000.

A motion which welcomed the decision to proceed with the construction of nuclear power stations in Great Britain was introduced by Dr. E. H. S. Burhop (Association of Scientific Workers). Dr. Burhop was critical of the statements made by Sir Robert Robinson, president of the British Association, on the atomic energy programme. Dr. Burhop said that even if the sale of plutonium were left out of account altogether, the cost would rise from 0·60d/kWh to only 0·70d. Also, the price of nuclear power was likely to decrease, while that of power from oil and coal would increase.

The motion, which also urged the Government to build still more nuclear power stations, was carried without opposition.

Policy on Wages

Mr. W. L. Heywood was critical of recent statements on the economic situation. He said that wages, profits and dividends continued to rise. How was it all going to end? He asked "Are we to go on pushing each other around, chasing our own tail?" He asked union executives to reflect seriously on the nature of the difficulties. They must try to continue to work out policies which would give them control over their economic fortunes. Above all, they must see that nothing they did would imperil full employment and the high living standards they had secured for their members.

Mr. F. Haxell (E.T.U.) introduced a motion declaring firm opposition to any form of wage restraint and support for the efforts of all affiliated unions to improve the wages and working conditions of their members. An amendment was moved by the Union of Shop, Distributive and Allied Workers which, while opposing arbitrary restrictions on the freedom of collective bargaining, wanted unions to continue to exercise appropriately their function of protecting and improving the standards of wages and working conditions in accordance with their own needs.

Mr. A. Birch, who moved the amendment, charged the E.T.U. with seeking to give the impression that Congress had been using powers it did not possess to oppose wage increases. What the General Council had done, was to give advice on these matters, but it could not impose this advice on the individual affiliated unions. Its advice on wage restraint had been, in effect, a warning to the unions against the unrestricted use of the bargaining powers that full employment gave them. The amendment was carried by 5,346,000 votes to 2,699,000.

The General Council was shy over nationalization. On two composite motions on the subject, it would not be committed and did not want Congress to be committed. It asked for the remission of both of them to the Council.

Industrial X-Ray Danger

Precautions and Qualifications

By E. H. W. BANNER, T.D., M.Sc., M.I.E.E., F.Inst.P.*

IT must be made clear at the outset that provided adequate precautions are taken, and qualified staff are employed, X-ray examination need introduce no additional factory danger.

A recent High Court action emphasizes the need for adequate precautions in the use of X-rays and other radiation methods in industry, where their adoption as a method of non-destructive testing is more recent than is their medical use. The plaintiff, formerly employed in a large engineering works on the radiography of welded steel pressure vessels, had in the course of his employment lost part of one arm. Such accidents were unfortunately fairly common in the early days of medical applications, but for many years this danger has been recognized and it is alarming that such an accident can occur to-day.

The plaintiff had been engaged as an "assistant radiologist," and the foreman in charge of the X-ray section was the "chief radiologist." The latter said that he had never heard of the published recommendations on X-ray precautions, although these first appeared in 1921 as the "Recommendations of the British X-ray and Radium Protection Committee," and have been revised at intervals. There are also the "Recommendations of the International Commission on Radiological Protection."

It was pointed out that the nature of the work precluded a system that could be made X-ray foolproof, and so required some knowledge of X-ray safety precautions on the part of all operators. The case is comparable with the medical one in which a radiologist is a professionally qualified scientist and the radiographer a trained technician. In this case the term "chief radiologist" gave a false sense of security, implying that sufficient radiological knowledge was present, whereas it was shown that few of the well-known safeguards were being practised. The action brought out the importance of employing qualified personnel. Professional advice is readily available and should be widely used, although fortunately this is an exceptional case, most industrial X-ray users being well aware of possible X-ray danger and acting accordingly.

In 1953 official recommendations were first published, these being "Precautions in the Use of Ionizing Radiations in Industry. Factory Form 342," issued by the Factory Department, Ministry of Labour and National Service. A recent Ministerial statement indicated that detailed special regulations were under consideration. Should such official regulations become law the position should improve as regards those firms who are not yet fully familiar with the possible danger, since they will have to be complied with by all industrial firms using radiation methods of inspection.

The use of a dental X-ray film carried or worn by all operators for a given period and subsequently correctly processed and replaced, enables a check to be made easily and cheaply, and this has been common practice for many years. More recently various electronic measuring instruments and monitors have been available for the purpose, these being either a self-contained pocket ionization chamber and electroscope, or a sealed ionization chamber carried in the pocket and used in conjunction with some monitoring instrument. In addition it is good practice to arrange for a regular medical blood count to be made on all workers liable to be exposed to X- or γ-radiation dosage levels exceeding 0·1 röntgen per week.

This case appears to be the first of its kind to come before the Courts, and the sum of £4,000 damages was awarded against the defendant firm.

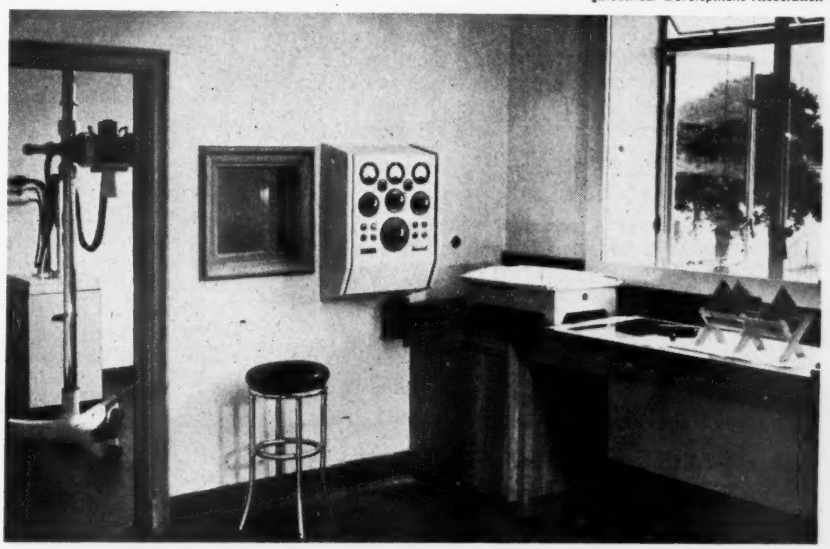
Appreciation of Danger

The question of X-ray danger appears to be a very simple one, answerable in a few words, but in view of the above legal case a more detailed explanation may be worth while.

X-rays having been employed in medicine (using the term in its widest sense) and in industry for many years, it is usual to consider that everyone, including the man in the street, knows of the inherent danger. It is not safe to make this assumption; neither is it sufficient for

X-ray installation at the E.D.A. Testing House. Visual examination of the screen is made through a window with all the controls in the outer room and no access to the X-ray room during examinations

[*Electrical Development Association*



* Consulting Engineer

operators just to be told that " X-rays are dangerous " and to expect this to be sufficient.

In the case of machinery the danger is usually obvious, and while new employees are warned of the danger there is usually some guard over the moving parts which makes the danger more obvious. In the case of high-speed shafts where the motion may be invisible extra warning is needed. X-rays, being invisible, are an insidious danger and the greatest care is therefore necessary in the instruction of all who may be involved, including people who may be in the vicinity during an X-ray examination, such as workmen who may have to convey large specimens to and from an X-ray department, although this should be a protected department, with suitable warning notices.

There is an exception, however. Where the X-ray examination can be made completely routine, as in the mass production of articles where the equipment can be designed for that particular purpose only, then the operation of the equipment can be made completely X-ray foolproof, requiring only non-technical operators, that is, with no X-ray knowledge other than the ability to judge the resulting radiograph or screen image.

In many instances routine examinations of certain foodstuffs are made by X-ray inspection visually by fluoroscopy. But the general principle is the same: X-rays must pass through the object under examination. In these cases of routine inspection by radiography and fluoroscopy the apparatus can be rendered completely X-ray foolproof, and in these circumstances no danger exists unless the precautions are wilfully disregarded, and operators need not be warned of X-ray danger since none exists.

Where fluorescence is used it is always best to ensure that X-rays do not pass directly to the viewer's eyes after going through the object and the fluorescent screen even with lead glass as a protection. The common practice of employing a mirror through which the screen can be seen by reflected light should always be adopted. Where this is done there is no danger to operators or to bystanders, but it may still be good policy to warn all concerned what would happen if they deliberately broke a window or otherwise became exposed to the X-ray beam.

The general case of the application of X-rays in an engineering or other industrial establishment needs to be considered in some detail, since it is here that harm can occur. In such works it is common for a variety of objects to be X-rayed, or at least various sizes and shapes of the material. The examination of castings for flaws of many kinds and of welded joints in steel vessels, such as those used under pressure, is so well known in engineering practice that it is only necessary to quote them for this to be realized. In few cases can a really X-ray foolproof installation be devised to be economically sound, and it is thus necessary to appreciate that danger is present through X-rays and to act on that assumption.

Radiologists and Radiographers

The use of X-rays in medicine, including both diagnosis and therapy or treatment, is much older than their use in industry. Medical application of X-rays was common even before the 1914-18 war, although of course the apparatus then in use was of much more primitive design and low output, and the knowledge of protection was also less fully developed. But even in those days it was known that danger was present, although how far individual workers appreciated it personally is another matter.

The whole science of the use of X-rays (and other ionizing radiations) is termed radiology. Within this broad overall term is the manipulative side, or the practical part of the production of radiographs, which is termed radiography. It is also well established in the medical field that a radiologist is a medical man who has subsequently specialized in radiology. Although this may appear to be self-evident it is stressed here, since it will be referred to later in an important connection. On the other hand a medical radiographer is a technician, who may be male or female, and it is usual to find that membership of the Society of Radiographers is insisted on: this is obtained by examination after training and experience.

A radiographer is thus a well-trained individual, with both theoretical knowledge and practical experience in the various component subjects, including electricity and magnetism, photography and of course anatomy. A regular course of instruction and practical training is obtained, the latter under the supervision of an experienced radiographer, who is himself subordinate to a radiologist. There is thus an established and clear-cut line of demarcation between the professionally trained radiologist and the skilled radiographer.

X-ray examination in industry provides a corresponding field for both the radiologist and the radiographer. In each case the general scope is roughly the same as the medical case, with the obvious exception that in the industrial case the medical knowledge is replaced by that of engineering and metallurgy. In some cases the degree of required competence is lower than in the medical world, especially when only a narrow field of work is involved, such as in the examination of welds in a given material. It is also true that in the medical case a full medical training is first undergone, while in the industrial case a radiologist may specialize earlier in his career and so become qualified in a shorter time than would his medical counterpart.

The same holds for the industrial radiographer; unless his work is limited to a narrow range of materials and articles he requires a course of technical instruction, followed by practical experience under supervision, comparable to that of the medical radiographer.

Advice Available

This point has been laboured thoroughly in order to try to make quite clear to industrial users of X-rays that the subject of radiology is a professional one, and not just a subject that can be picked up by a man as he goes along, or after a few days' tuition by a man who himself may not be qualified and experienced. Any industrial establishment using radiology or ionization methods of examination should have available expert knowledge, with higher supervision from time to time. It is true that economics has to be considered, and it is often the case that the amount of work, and its value, may not cover the cost of a full-time qualified radiologist. But advisory services are available, including those of the Factory Department of the Ministry of Labour and National Service and of the Radiological Protection Service (Ministry of Health and Medical Research Council), Downs Hospital, Cotswold Road, Sutton, Surrey. There is also some merit in employing an outside consultant who will probably be in touch with other and somewhat similar installations and so be of more assistance through his wider knowledge of comparable conditions, as regards safety precautions, in other works than would a resident radiologist.

The various recommendations are detailed below:—

(1) Recommendations of the British X-ray and Radium Protection Committee (7th edition, 1948).

(2) Recommendations of the International Commission on Radiological Protection (revised 1954). Published as Supplement No. 6, *British Journal of Radiology*.

(3) Precautions in the use of Ionizing Radiations in Industry. Factory Form 342 (H.M.S.O., 1953).

The references to protection and the need for adequate care are fully in agreement with the policy of the Factory Department, Ministry of Labour and National Service.

Electricity in Factories

ANALYSIS OF ACCIDENTS AND THEIR CAUSES

THE publication of the Factory Department of the Ministry of Labour and National Service entitled "Electrical Accidents and their Causes" for 1953 (60 pp., H.M. Stationery Office, 3s) was made available last week. It records that the number of reportable accidents (those involving disablement for more than three days) in that year was 744, of which 40 were fatal; corresponding figures for 1952 were 721 and 38 and for 1946, 769 and 33. There were also 104 dangerous occurrences (compared with 130 in the previous year) due to explosion or fire through failure of electrical apparatus for prescribed periods. In addition 86 fatalities not reportable under the Factories Act came unofficially to the notice of the Department; 45 of these occurred on domestic premises.

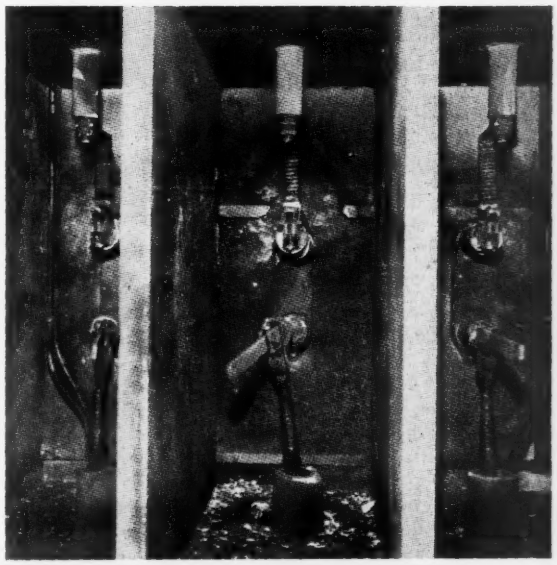
Excluding 162 cases of welding eye flash, 35 per cent of the 582 other accidents (divided nearly equally between skilled and unskilled workers) were associated with portable apparatus, which accounted for 40 per cent of the fatalities. Incidental injuries from falls or from machinery in many cases resulted from shocks.

Approximately half of the 75 accidents during testing were occasioned by the use of improvised portable test sets including lamps, although several types of safe outfits are on the market. About one-third of the total electric shock accidents (300) were consequences of failure of the earthing system, i.e. electrode and earth-lead and earth-continuity conductors. The commonest form of injury was burn, 347 cases, those involving both shock and burn numbering 104, but the great majority of deaths were due to shock, with 17 of the 40 at less than 250 V.

Artificial respiration was applied successfully in 18 and unsuccessfully in 20 instances. Immediate application of the Holger-Nielsen system is urged.* A number of firms have started periodical instruction in this method.

Improvements in the electrical equipment of factories that sometimes accompany change-over to standard systems of supply do not always extend to the wiring. Commendatory reference is made to the use by contractors of not more than 110 V for portable appliances, especially in power station construction. Earthing of the mid-point of the transformer secondary and the use in damp situations of 25 V to earth is recommended. Heavy-duty t.r.s. cables, further protected where necessary in canvas or rubber hose, or screened, are generally used. Where risk of damage by heavy machinery exists metal sheathed three-phase four-core cables have been installed. On some sites all cables at above 65 V to earth are metal clad and core-balance earth-leakage protection is provided for medium-voltage cables. The need for development of an ultra-violet lamp at a lower voltage than 240 for detecting leaking tubes in condenser water boxes is noted.

Main features of switchgear failure (as tabulated) indicate the necessity of expediting the replacement of switchgear of insufficient rupturing capacity. Transformers of 500 kVA would meet most factory requirements and with sectionalizing would limit short-circuit conditions to 10,000 kVA. Venting above the oil of acetylene and hydrogen formed by arcing under oil or of inflammable



Effects of opening air-break isolators on load

gases generated by the overheating of some solid insulating materials is essential. Auto-reclosure of circuit-breakers, where adopted, should be rapid, and motor starters affected should have no-volt protection if restarting entails danger; co-ordination of protection of factory transformers with auto-reclosure fuses and momentary loss of heater or filament temperature of electronic apparatus are among points to be considered. Air-break isolating switches should not open circuits on appreciable load and are liable to fail even when breaking magnetizing currents (see accompanying photograph).

A fatal accident is cited to indicate that permit-to-work cards must not be issued to subordinates engaged on such work as busbar maintenance until after the senior authorized person has supervised the fitting of any removable screens required. To guard against internal explosions due to inter-turn faults in transformers, particularly when operated in parallel, the use of Buchholz type protection is strongly advocated in important sub-stations.

Dielectric heating equipment should have back-up protection for enclosure-interlocks incorporating contactor or micro-switches, but progress in that direction is reported to be slow. The increased development of electronic apparatus recently has led to spectacular improvement in quality and output, especially in the processing of steel, while the accident rate from its use has fallen.

Difficulties in obtaining low resistance earth electrodes in rural areas continue to give anxiety. In any case attempts to earth 240 V single-phase of 415 V three-phase apparatus by short spikes or pipes driven into the ground are regarded as futile. In factories generally the "borrowing" of neutrals from another source of supply is strongly deprecated, as disconnection of the neutral from its normal

* This is the method which forms the basis of the *Electrical Review's* instructions for dealing with cases of apparent death from electric shock.

earth connection may cause its voltage to rise to phase-to-neutral value.

Precautions recommended in testing radio and television sets are that the work should be carried out in an earth-free area, where the tester can stand on a wooden or otherwise insulated floor. All sets should be supplied from double-wound isolating transformers, a separate transformer being used for each set under test, if close to others, in view of the possible connection of adjacent chassis to different poles.

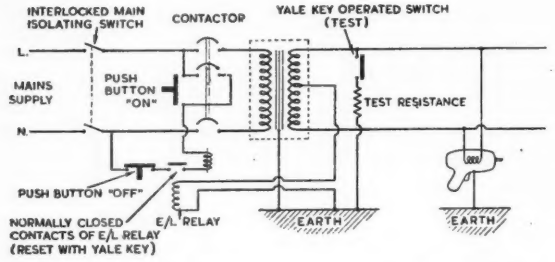


Fig. 1.—Earth-leakage protection system incorporating controlled maintenance for portable tools

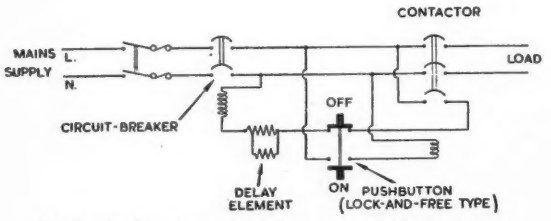


Fig. 2.—Back-up protection for contactors liable to sticking

There is a noticeable increase in the use of the simple and reliable high-cycle low-voltage three-phase system for portable tools, which has not been associated with any fatal accidents. Numerous accidents have occurred with portable tools because of the lack of regular procedure (with records) in regard to the testing of the continuity of the earthing circuits, both in the flexible cable and the plug and socket. The earth core of flexible leads should be tested by a substantial current rather than by a small battery so as to ensure mechanical as well as electrical soundness, preferably by a special test set as now available from several manufacturers. Tests of continuity should ensure that the resistance of the earth circuit is low enough to cause the operation of all fuses or circuit-breakers in an installation under fault conditions. The records kept should enable gradual deterioration to be readily detected. Other records should indicate the results of earth-loop impedance tests which should be carried out at regular intervals at all socket outlets.

In the scheme illustrated in Fig. 1 a sensitive relay (4,000 ohms impedance), connected between the mid-point of the recording winding of the step-down transformer and its earthed tank, operates instantaneously when an earth-fault current exceeds 9·5 mA at 110 V and locks out a contactor controlling the transformer primary. The relay is re-set by a Yale key under the control of an authorized person; the key when turned in the opposite direction connects an 8,000 ohms resistance between one pole of the supply and the end of the relay coil.

The sticking-in of contactors is most frequently caused by welding of bouncing contacts and sometimes by lack of free mechanical movement of the armature and residual magnetism in the laminations of the core and armature. In the inexpensive back-up safeguard shown in Fig. 2 a circuit-breaker is tripped if the contactor stays in the closed position when the control switch or push button is in the off position. A delay element (for only a fraction of a second) ensures that the circuit-breaker does not open when the contactor is operating normally.

Contact with live trolley wires for cranes caused several serious accidents, two fatal, and the trend is towards completely enclosing the wires or dispensing with them altogether. Absence or failure of overwinding and over-lowering devices has also been responsible for other dangerous occurrences; the importance of fitting the latter device in certain circumstances is strongly emphasized.

Under the heading of electrostatic hazards, it is stated that at above 60 per cent atmospheric humidity the formation of dangerous charges appears to be prevented. The special precautions necessary in hazardous industries are presented at some length. Among other aspects discussed are the protection of transformer windings against over-voltage and carrier-current and other protective systems. Brief accounts are given of typical accidents and dangerous occurrences in support of the various recommendations made.

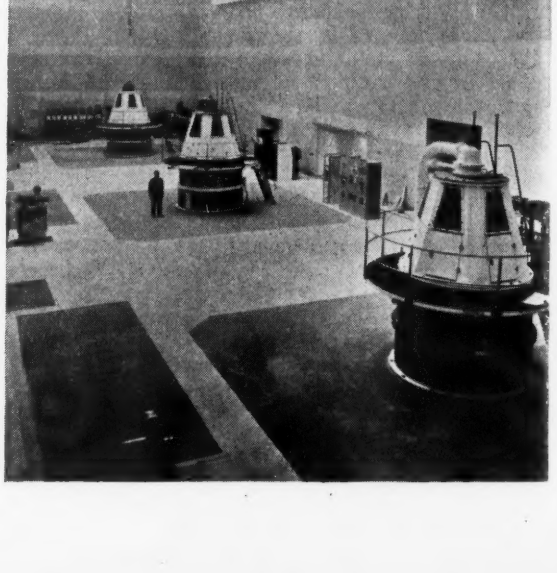
Spanish Hydro-Electric Station

On 3rd September the Los Peares hydro-electric power station in Galicia, Spain, was officially opened by General Franco, head of the Spanish State. The main power station contractors were the British Thomson-Houston Co., Ltd., who have sent us an excellent brochure describing the installation in detail.

Three 62,400 kVA generators are installed, driven by Boving & Co. Francis-type turbines each of 72,800 h.p. at the maximum head of 305ft and running at 214 r.p.m. Ten single-phase 20,500 kVA transformer units, distribution transformers, switchgear, controls and auxiliaries were all supplied by the B.T.H. Co.

The operating authority is Fuerzas Electricas del Nøroeste S.A. (FENOSA), formed in 1943 to exploit the natural resources of Galicia.

General view of machine room of the Los Peares station

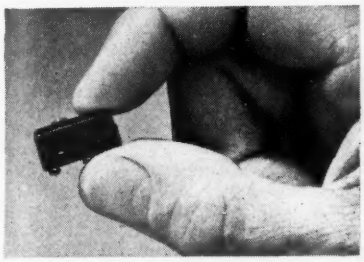


NEW ELECTRICAL EQUIPMENT

Micro Switch

To meet the demand for smaller micro switches BURGESS PRODUCTS CO., LTD., Micro Switch Division, Dukes Way, Team Valley, Gateshead, 11, have introduced the V4 "switchette" which is so small that twelve can be packed into a matchbox. The approximate overall dimensions are ¾in by ½in by ¼in.

Of robust construction and housed



Burgess V4 micro switch

in Bakelite the switch will make and break 5 A at 250 V a.c. or 2 A at 30 V d.c. and has a probable life of 50,000 operations. It is a single-pole change-over switch with a positive snap action and the contact separation is 0·010in minimum.

The switch is operated by depressing a small plunger and for applications where it is not possible to apply the operating force at 90 deg to the alignment of the switch or when the actuating medium is a cam or sliding dog, auxiliary actuators with either plain levers (V4L1) or roller levers (V4LR1) are available.

Commercial Vehicle Lamps

Short, robust filaments which will give an improved performance under vibration are fitted to the new Osram 24 V 6 W bulb for the side and tail lights of commercial vehicles. This is made by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2.

Osram vehicle bulb

The new bulb, which will supersede the existing Osram 24 V bulb, is now in production and will be available at the same list price of 1s 6d. It has been developed following intensive field tests on heavy commercial vehicles. Using a double bead construction it has two short 12 V filaments arranged in series which will withstand greater vibration than the long single 24 V filament previously employed. The catalogue numbers remain unchanged; they are No. 149 for a bulb fitted with an s.c.c. cap and No. 150 for a bulb fitted with an s.b.c. cap.

Sealed Relays

MEASURING INSTRUMENTS (PULLIN), LTD., Winchester Street, Acton, London, W.3, have developed an addition to their S-type range of precision multi-pole change-over relays. This is a sealed type which, while using basically the same mechanism as the existing types and being produced in the same ratings, incorporates a much improved sealing method together with a significant reduction in weight and bulk.

The main features of the new sealed type are a neoprene gasket and an entirely new wiping action, giving 0·015in sliding movement of the contact surfaces, on which a contact pressure of 35 grams is exerted. The standard contact material on the normal S-type relays is "Elkonite," a nickel-silver alloy, with precious metal (such as platinum-gold-silver) as an alternative if required. Relays specified for fighting vehicles have nickel-silver contacts for heavy current duty and palladium contacts for light current duty.

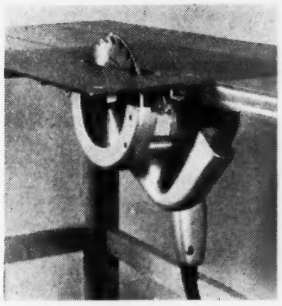
Pullin sealed relay

Tests have established that the relays withstand forces of up to 20g, and vibrations of 0·003in amplitude at 250-8,000 cycles per minute frequency.

Portable Tool Accessories

Production has now commenced on four new attachments for the "Utility" range of home handyman equipment manufactured by BLACK & DECKER, LTD., Harmondsworth, Middlesex. The attachments are a portable saw table, a lathe saw table stand, a lathe boring attachment and a sanding plate, all of which can be operated by either the sander-polisher drill or ¼in "Utility" drill.

The saw table attachment (price £1 13s) has been introduced for use in conjunction with the portable saw attachment which it converts into a robust saw table. The table is manufactured from ¼in plate and measures 12in by 10in. It is designed to be permanently attached to a workbench and when in position lies flush with the bench top. It is possible to cut wood up to 1¾in depth and also to make angle cuts up to 45 deg, the saw blade slot being of sufficient width to



Cut-away view of a workbench showing the Black & Decker portable saw table

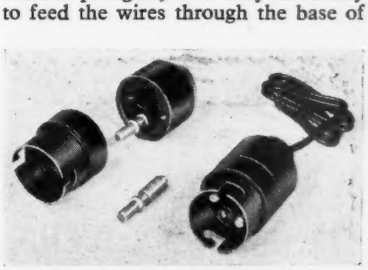
enable this to be effected. So that owners of the ¼in "Utility" horizontal drill stand can use the lathe saw table without the necessity of purchasing a lathe, a saw table stand (price 19s 3d) has been introduced.

The purpose of the lathe boring attachment (price £1) is to enable the home handyman to bore suitable holes through lampstands and pedestals in order to pass through electric lighting flex. It consists of four components, a boring tool, a driving dog, a tailstock hollow centre and centre pin. It is designed to bore ¼in diameter central holes of up to 12in in length through any piece of wood capable of being turned between centres in the lathe.

The metal sanding and sharpening plate (price 7s 6d) is of new design and replaces the face plate previously supplied with the woodturning lathe and sanding table attachment. It can also be obtained as a separate attachment.

Lighting Fitting Lampholder

An improved type of b.c. lampholder, specially designed for the lighting fittings industry, has been developed by JACK SCHRIER, 2, Jamestown Road, London, N.W.1. The M.A.M. holder has the advantage that wiring connections can be carried out from the top. For the purpose of connecting the electrical leads to the contact plungers, it is only necessary to feed the wires through the base of



M.A.M. lampholder (Jack Schrier)

the holder and wind the bared ends around the appropriate plunger. Thus the need for the usual grub screws is dispensed with.

The cap is replaced and fixed by two screws, held in position by fibre washers. When assembled, the fact that no flange is incorporated in

the fitting allows for a smaller gauge candle tube to be fitted over the complete holder. Whereas only a 1¼in holder could be used with the standard b.c. holder, the smaller and neater 1in size, as used on s.b.c. holders, can be fitted.

Loop Impedance Tester

A high current neutral loop impedance and earth continuity tester has recently been designed and introduced by MERITUS (BARNET), LTD., Wood

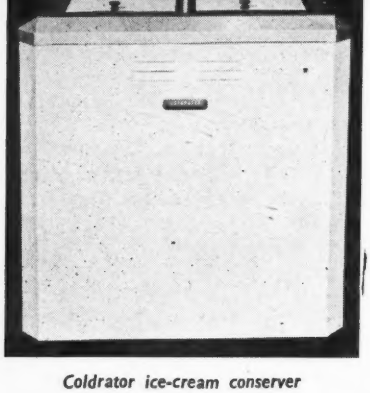
"Meritus" impedance and continuity tester

Street, Barnet, Herts. The instrument is designed primarily to test for all the common faults on electrical installations and appliances. It injects a current up to a maximum of 20 A into the circuit under test in order to detect faults which do not always show up when low values of test current are used. Operation is from a 200/250 V a.c. supply.

Ice Cream Conservers

The Coldrator Division of the HOTPOINT ELECTRIC APPLIANCE CO., LTD., Peterborough, announces the introduction of two ice-cream conservers, the LTS.725 and LTS.345. An interesting feature of these two models is the flow of air which is kept circulating between the exterior of the insulation and the outer shell, preventing excessive condensation on the walls of the cabinet.

The shell of each of the cabinets is of heavy gauge sheet steel and is finished in white stoved enamel. The interior is of heavy gauge "Birmabright" and the cabinets are mounted on casters to ensure easy and silent



Coldrator ice-cream conserver

movement. The lids are of the double "flip-flap" type.

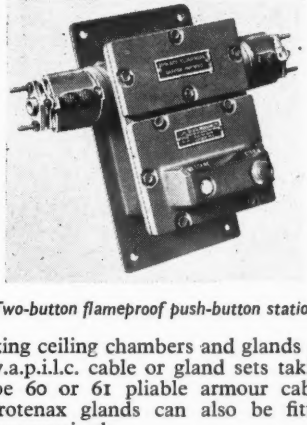
A 3in thickness of fibre-glass entirely surrounds the thermostatically controlled storage well. The refrigerating system uses a motor-compressor unit which is sealed in a steel shell and spring mounted to eliminate noise and vibration.

Storage capacity of the LTS.725 is 7·25 cu ft and of the LTS.345 3·45 cu ft, and they are priced at £112 10s and £83 respectively.

Flameproof Push-button Stations

New types of flameproof push-button stations for mining and industry are now being produced by W. & H. NELSON, LTD., at their Mossend works, Bellshill, Lanarkshire. The units are the latest additions to a range of equipment designed to provide maximum safety in industrial electrical plant.

Amongst the features of the new FLP push-button stations are roomy connection chambers and alternative connecting arrangements available on each switch. The units are fitted with connecting arrangements suitable for



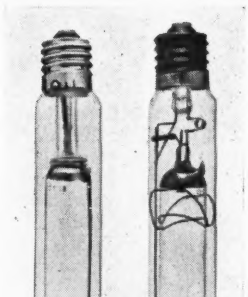
Two-button flameproof push-button station

taking ceiling chambers and glands for s.w.a.p.i.l.c. cable or gland sets taking type 60 or 61 pliable armour cable. Pyrotenax glands can also be fitted when required.

Type PBF/1 is a two-button unit generally used for starting and stopping; PBF/2 is a standard emergency stop button, suitable for wall mounting; PBF/3 is a three-button unit which can be used for forward, reverse stop-start, inch stop, etc.

Mercury Vapour Discharge Lamps

Original features have been incorporated in the latest mercury vapour discharge lamps of CROMPTON PARKINSON, LTD., Crompton House, Aldwych, London, W.C.2. These yield a higher standard of maintained efficiency and markedly increased mechanical strength. In the new design the inner glass tube containing the mercury vapour and electrodes is securely held between two sturdily constructed stems which are integral with the outer glass envelope. Asbestos pads between the inner tube and the stems provide both a cushioning effect and an allowance for expansion due to heat. It is claimed that there is no bulb discoloration due to overheated wirework being in contact with glass; depreciation in light output throughout life is therefore substantially reduced. It has been shown, in fact, that the new lamps retain their original internal cleanliness after 4,000 hours' use. In addition, the avoidance of contact between hot wire work and glass eliminates glass fracture at local hot spots when the lamps are on and subjected to external cold air currents.



The new Crompton Parkinson mercury vapour lamp on the left compared with an older type

The lamps are available from stock in 250 and 400 W sizes, and prices remain as for other E.L.M.A. mercury discharge lamps.

"Q" Meter

A "Q" meter of novel design is announced by ADVANCE COMPONENTS, LTD., of Marlowe Road, Walthamstow, London, E.17. This addition to their range is a small, compact instrument for making r.f. measurements of circuit magnification, inductance, capacitance and power factor at frequencies between 100 kc/s and 100 Mc/s. Intended for mains operation it is mounted on a substantial aluminium panel and fitted in a steel case finished in grey enamel. The test terminals are rhodium plated and protrude through a polythene insulating plate on the top of the case. The price of the unit is £55 net.

Advance "Q" meter

Brazilian Expansion

Electricity Consumption Outpacing Extensions

FROM OUR RIO CORRESPONDENT

DESPITE considerable reinforcement of the Light & Power Co.'s installed capacity on the River Paraiba and the installation of the thermal-electric station of Pedreira, Sao Paulo has been obliged to re-introduce rationing. Daily consumption, which averaged 10·5 million kWh in 1954, is of the order of 11·5 million this year and rises frequently to 13·5 million. As a result the power problem is still far from a solution and electrification programmes are being speeded up.

The Pirapora Dam will be completed within three months and will convert the bed of the Tiete River between Parnaiba and Pirapora into an immense reservoir. From Parnaiba, where a dam and power plant already exist, water will be pumped to the Billings Reservoir and, later, will augment supplies to the underground station at Cubatao. The latter should begin operating early in 1956.

The Minister of Communications and Public Works, replying to an inquiry by the Senate, said recently that the $90 million loan, obtained by the Brazilian Traction, Light & Power Co. from the World Bank, was exhausted by imports of materials and equipment to expand the company's services. The sum of $74 million was spent on the following works, but the total cost exceeded that sum by an appreciable amount:—The diversion of the Paraiba-Pirai Rivers, including hydraulic works, pumping plant and the 330,000 kW Nilo Pecanha station; the fifth group of 45,000 kW generators at Pombos Island; two 65,000 kW groups at the Cubatao station; the floating station at Piraque, of 30,000 kW capacity; and the 75,000 kVA frequency maintenance station at Aparecida. The last-named allowed the Rio and Sao Paulo systems to be interconnected, boosting supplies to Sao Paulo when required. All the above works had been completed and inaugurated, adding 535,000 kW to the Rio and Sao Paulo systems. The balance of $16 million was spent on equipment and materials for the company's telephone services.

Tax to Finance New Construction

Notwithstanding Brazil's difficult financial situation the Minister of Finance continues to find the funds for official programmes, with the aid of a new federal tax on electricity consumption. During the past two months the National Bank for Economic Development was authorized to advance the equivalent of £15 million for installing new power plants or extending existing ones. The biggest loans went to the Companhia Hidroelectrica do Rio Pardo, for stations at Limoeiro and Euclides da Cunha, rated at 172,000 h.p.; to the Companhia Paulista de Forca e Luz to increase its capacity by 125,000 kW; to the State of Espirito Santo and to Central Electrica do Piau to complete the installations at Rio Bonito and on the River Piau.

In addition to the above sums a grant of £500,000 has been made to the State of Goias from the funds of the extinct "Salte" Plan to complete the hydro-electric station at the Dourada Falls. The Commission for the Economic Development of the Amazon Basin, an autonomous Government agency with its own funds, has signed contracts for the construction of a hydro-electric station at Paredao, in the Amapa Territory, to cost £2 million. So far, this area of 53,000 square miles and 38,000 inhabitants in the far north has had no electric power, but the discovery of important mineral reserves, now being exploited by Bethlehem Steel and others, the building of a railway and port to serve the mines and the opening up of new industries has entirely altered the aspect of this remote territory.

The Bank of Brazil has been authorized to pay the equivalent of £3 million, in five monthly instalments, to the Companhia Hidroelectrica do Sao Francisco. Eight additional cities are now being connected to the company's system in the State of Pernambuco. To date consumers have only been found for 40,000 kW of the available capacity of 180,000 kW, but supply companies in north-east Brazil are gradually connecting their systems and a number of manufacturers in the over-industrialized south plan to start production in the area served by the Paulo Afonso station.

Private Power Supplies

Important companies, starting or increasing production in Sao Paulo and elsewhere, must now provide their own power. The Companhia Brasileira de Aluminio recently inaugurated plant 45 miles from the city of Sao Paulo to produce 10,000 tons of aluminium annually and is building a 40,000 h.p. hydro-electric station on the River Juquia-Guaca. The Companhia Siderurgica Paulista is to construct a 25,000 kW thermal station adjoining the site of its Piassaguera steel mill. The National Coal Fund provides the capital required for thermal stations, burning local coal, near the Rio Grande and Santa Catarina coal mines. The Cia. Siderurgica Belgo-Mineira, which has its own hydro-electric station and generating plant, using blast-furnace gas, is raising its capacity to meet increased demands under its steel expansion programme.

Several new schemes to increase installed capacity are now under consideration or have been approved in the past few months. The President of the Republic has authorized the Sao Francisco Valley Commission to sign contracts with the Centrais Electricas de Minas Geraes and the Morrison Knudsen Company to draw up a project for building a dam across the Sao Francisco River at Tres Marias, near the mouth of the Barrachudo River. The dam, which forms an essential part of the plan to develop the resources of the Sao Francisco Valley, will represent an eventual addition of 880,000 h.p. to the available potential. It will ensure an abundant supply of power and enable the flow of water to be controlled, avoiding seasonal variations in level, which alternately impede navigation and flood the countryside.

The Sao Francisco River flows for 1,814 miles from the Cadastra Mountains, through Minas Geraes and Bahia to the Atlantic at Penedo. Over half its length navigation is interrupted by cataracts and sand banks. The 1946 Constitution obliges the Union to devote one per cent of its revenue from taxation to improvements in this hitherto neglected, but fertile, valley. Falls are being harnessed, swamps drained to rid the zone of malaria, and the river cleared of obstructions. Dams and sluices are being built to regulate the flow.

The Foreign Trade Department has been authorized to license imports, without exchange cover, of essential equipment for basic industries. Absolute priority will be given to materials for hydro-electric installations.

Financial Section

STOCKS and SHARES

FOLLOWING last month's slump in prices and a spell of highly erratic behaviour, markets of the Stock Exchange began in the first part of this month to recover some better semblance of stability. At the same time, the amount of business remained restricted by a disposition to await further evidence of the extent to which the country's economic difficulties are yielding to the Government's treatment of them. The hiatus gives an opportunity to take stock of the position in the electrical markets during the course of a year which has produced some unusually wide and sudden swings, one of which occurred at the beginning of the present week, when British Government stocks took a sudden turn for the better.

Fluctuation

In the gilt-edged market, this year's tale to date is, however, one of fall and decline. Depressed early in the year by the two increases in Bank Rate, prices became progressively affected by the effects of the dearer money policy, and, more recently, by the tightening of the "credit squeeze." Quotations have now reached levels not plumbed since the bad days of 1931-32, and still exhibit nervousness as each Thursday—the date for the Bank Rate decision—comes round. Industrial share prices also suffered a reverse in the first quarter, but after the General Election bounded forward until pulled up and put sharply into reverse, at the height of the holiday season, by the measures introduced to check economic deterioration. On the average, prices lost in a month about 15 of the 20 per cent net appreciation previously gained.

Electrical Equipment Shares

As a group, electrical equipment and engineering shares have given one of the best of this year's displays in the industrial markets. With others, they felt the benefit of many good financial reports and dividends. On the introduction of the railway electrification plans and the atomic power projects, this became a particularly well-favoured field of investment. As the preceding comparisons show, some shares have retained large net appreciation despite the severity of last month's setback.

Scrip Issues

Prices quoted in the above and following tables are adjusted, where

Ord. Shares	Price Jan.	Price Now	Change
A.E.I.	62/6	86/3	+ 23/9
Brush	7/6	8/6	+ 1/-
Crabtree	30/6	29/6	− 1/-
Crompton P.	16/9	16/6	− 3d
Elec. Constr.	35/-	32/6	− 2/6
English Electric ...	55/-	77/6	+ 22/6
G.E.C.	58/9	66/3	+ 7/6
Lancs. Dynamo ...	37/-	52/6	+ 15/6
C. A. Parsons	57/6	86/3	+ 28/9
A. Reyrolle	88/9	105/-	+ 16/3
Allen West	12/-	13/3	+ 1/3
Westinghouse	85/-	94/-	+ 9/-

The Week's Price Changes

Company or Board	Nom. Value	Middle price 12th Sept.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1955 Highest	1955 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	76½		3	3	3 18 6	94⅞	76½
Brit. Elec. 1974/77	100	75½		3	3	3 19 6	93⅞	75½
Brit. Elec. 1976/79	100	80½	−1	3½	3½	4 6 9	98¼	80½
Brit. Elec. 1974/79	100	90½		4¼	4¼	4 14 0	109	90½
Overseas Electric Supply								
Calcutta Elec.	£1	22/6		6†	6†	5 6 9	22/6	20/9
East African Power	£1	22/6		7	7	6 4 6	24/6	19/9
Nigerian Elec.	£1	22/-	−6d	10	10	9 1 9	27/-	22/-
Palestine Elec. "A"	£1	21/-		Nil	Nil	—	22/9	21/-
Perak Hydro-Elec.	£1	20/-		6	10	10 0 0	21/6	17/9
Equipment and Manufacturing								
Aberdare Cables	5/-	12/3	+3d	12½	17½	—	14/6	11/-
Aerialite	1/-	6/6	+3d	88½	88½	—	6/7	5/3
Allen, W. H.	£1	77/6		20	20	5 3 3	83/9	77/-
Aron Elec. Ord.	£1	57/6		15	15	5 4 3	63/9	55/6
Assoc. Elec. Ord.	£1	86/3		11½	14	3 5 0	96/-	62/6
Automatic Tel. & El.	£1	65/- x.d.	−2/-	15	15*	4 12 3	79/6	65 -
Babcock & Wilcox	£1	83/9		12*	15	5 11 9	98 -	68 6
Baldwin, H. J.	2/-	4/9		20	20	8 8 6	5/6	4/4
Bakelite	10/-	32/6		12½	16	4 18 6	34/6	27/-
British Aluminium	£1	51/6	+1/6	10	12	4 13 2	58/-	35/3
B.I. Callender's	£1	45 -	−1/-	10	10	4 9 0	55,3	44 9
B.I. Callender's 6% Pref. ...	£1	21/9	−3d	6	6	5 10 3	26/6	21/9
British Thermostat	5/-	31/3		27½	27½	4 8 0	35/-	22/6
British Vac. Cleaner	5/-	7/6		25	30	—	10/	7/-
Brook Motors	10/-	46/3		20	20*	4 6 6	46/3	39/9
Brush Ord.	5/-	8/6		6	10	5 17 9	9/6	7/7
Bulgin, A. F.	1/-	7/-		30	45	6 8 6	8 -	4/-
Burco Dean	5/-	13/3		—	—	—	17/3	13/3
Chloride El. Storage	£1	67/6 x.d.	+ 1/3	12½	17½	5 3 8	77/6	58/6
Clarke Chapman	£1	100/-		20	20*	4 0 0	102/6	68/9
Cole, E. K.	5/-	22/9	+9d	27½	17½*	3 17 0	25/6	18/3
Cossor, A. C.	5/-	10/9 x.d.		10	15	6 19 6	14/-	8/9
Crabtree	10/-	29/6	−9d	17½	20	6 15 6	34/6	29/3
Crompton Parkinson Ord. ...	5/-	16/6		20	20	—	19/9	16/-
De La Rue	5/-	20/6	+6d	20	30	7 6 3	26/-	18/9
Decca	4/-	41/3	+2/6	35	56½*	—	48/9	31/-
Desoutter	5/-	33/9 x.d.		20	25	3 14 0	35/-	25/6
Dewhurst	2/-	10/-		19	24	4 16 0	10/6	7/3
Dictograph Tel.	2/-	7/6	−6d	20	20	5 6 8	9/3	6/6
Dubilier Condenser	1/-	4/3		25	25*	5 17 9	5/7	3/10
E.M.I.	10/-	26/6	−3d	8	10	3 15 6	37/-	25/3
Electrical Components	5/-	18/9		20	25	6 13 4	21/3	15/3
Elec. Construction	£1	32/6		15	8½*	5 4 6	41/3	31/6
Enfield Cable Ord.	£1	21/3		Nil	Nil	Nil	25/3	20/-
English Electric	£1	77/6		10	12½	3 4 6	86/9	54/3
English Electric 3½% Pref. ...	£1	14/-		3½	3½	5 7 3	16/9	14/-
Ericsson Tel.	5/-	40/6		25†	20†*	2 9 6†	46/6	29/-
Ever Ready	5/-	31/3	−6d	40	35*	5 12 0	38/-	22/3
Falk Stadelmann	£1	44/-	+1/6	15	15	6 16 4	52/6	42/-
G.E.C. Ord.	£1	66/3		12½	14	4 4 10	80/3	51/3
G.E.C. 6½% Pref.	£1	23/9		6½	6½	5 9 5	28/4	23/6
General Cables	5/-	15/3	+3d	30	30	9 16 9	17/-	15/-
Greenwood & Batley	£1	56/-	−1/6	17½	17½	6 5 0	57/6	54/6
Hackbridge Cable...	5/-	20/9 x.d.		20	25	6 0 6	22/6	14/-
Hackbridge & Hewittic	5/-	20/6		25	30	—	24/9	17/-
Hall Tel. Acc.	10/-	19/6	+6d	10	10	5 2 7	22/6	11/-
Heatrae	2/-	5/-		12½	15	6 0 0	5/9	4/3
Henley's	10/-	16/6	−6d	10½	10½	6 7 3	21/3	16/6
Holophane...	5/-	16/3	−1/3	20	25	7 13 9	19/9	16/-

* After scrip issue. † Free of income tax.

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.

necessary, in accordance with scrip issues during the course of this year. During this period, it may be noted, people have become more accustomed to the change in the official description of these operations as "scrip" or "capitalization" issues in replacement of the older term of "bonus shares." No doubt the object of the alteration was to correct the impression that a capitalization of reserves, which represent in most cases the accumulation of profits ploughed back over many years into a business, bestows some free benefit upon the shareholders concerned. The term "bonus" can, of course, be used very easily to give that wrong impression of a book-keeping transaction by which the issued capital of a progressive firm may periodically be adjusted to conform with the growth of the assets on the other side of the balance sheet.

...in Electrical Investments

Company or Board	Nom. Value	Middle price 12th Sept.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield % £ s d	1955 Highest	1955 Lowest
Equipment and Manufacturing—continued								
Hoover	5/-	42/-	−1/6	45	70	8 6 9	52/6	40/-
I.C.I.	£1	51/3	+6d	15	10°	3 18 0	61/9	38/3
Intl. Combustion	5/-	19/-		20	25	—	24/6	16/3
Johnson & Phillips	£1	43/3		15	15	6 18 9	52/6	41/-
Lancashire Dynamo	£1	52/6 x.d.		14	15	—	56/3	37/3
Laurence, Scott	5/-	18/-		20	12½°	3 9 0	19/6	14/6
Lister, R. A.	£1	32/6		12	9·3°	5 14 6	40/-	30/6
London Elec. Wire	£1	51/3		10	12½	4 17 6	61/3	50/6
Lucas, J.	£1	46/3		10·8	7½°	3 4 9	56/6	41/6
Marryat & Scott	2/-	12/3		25	30	4 18 0	13/-	9/6
Mather & Platt	£1	64/6	−1/-	15	13·4°	—	75/-	48/-
Metal Industries	£1	26/6		9	9	6 15 9	38/-	26/6
Midland Elec. Mfg.	£1	50/-		15	10°	4 0 0	55/-	44/-
Morphy-Richards	4/-	30/-	+2/6	40	35°	4 13 3	35/-	27/-
Murex	£1	61/3	+3/9	15	15	4 18 0	66/-	49/3
Newman Ind.	2/-	2/9		10	10	7 5 6	3/6	2/4
Oldham & Son	1/-	2/9	−3d	17½	20	—	3/6	2/1
Parnall (Yate)	5/-	9/-	+3d	8	14	7 15 6	13/2	7/3
Parsons, C. A.	£1	86/3		7½	10	2 6 6	100/-	56/-
Plessey	10 -	75/-	+4·3	30	20°	2 13 3	89/-	57/6
Pye Deferred	5/-	41/3	+1/3	20	12½°	3 0 7	47/6	28/6
Revo	10/-	13/9		27½	9°	6 11 0	15/6	12/6
Reyrolle	£1	105/-	−5/-	13¾	15	2 17 3	127/6	89/-
Rheostatic	4/-	12/9x.d.		20	22½	—	14/3	9/3
Richardsons Westgarth	5/-	16/-	−3d	15	15°	4 13 9	19/-	11/-
Scottish Cables	4/-	18/9		27½	27½	5 17 3	22/6	18/9
Smith (England), S.	4/-	16/6	+6d	15	17½	4 4 9	20/-	15/-
Southern Areas	£1	32/6		7½	10	6 3 0	38/-	27/6
Strand Elec.	5/-	8/9x.c.		17½	15°	—	13/3	8/6
Sturtevant	5/-	31/3	+1/3	18·9	14·4†°	2 6 0†	35/9	21/-
Sun. Elec.	£1	35/-		15	15	8 11 6	35/-	33/9
Switchgear & Cowans	5/-	13/9		10	20	7 5 6	17/-	11/-
Taylor Tunnicliff	5/-	13/9		12½	15	5 9 0	16/3	11/3
T.C.C.	10/-	51/3	−1/3	30	25°	4 17 6	53/9	41/-
T.C. & M.	£1	32/6	+6d	8½	8½	5 4 6	40/9	32/-
Telephone Mfg.	5/-	10/6	−3d	10	10	4 15 3	11/6	9/3
Thorn Elec.	5/-	23/6	+1/-	20	15°	3 3 9	33/-	13/9
Thornycroft	£1	40/-	−2/6	15	15	—	47/6	34/6
Tube Investments	£1	92/6	−2/6	15	17½	3 15 9	107/6	72/6
Vactric	5/-	17/6		10	15°	4 5 9	22/-	12/-
Veritys	5/-	11/-		12½	12½	5 13 3	11/-	7/-
Walsall Conduits	4/-	14/6		70	70	—	17/3	12/-
Ward & Goldstone	5/-	32/6	−2/-	50	30°	4 12 3	45/-	32/6
Watford	2/-	8/-		22½	25	—	8/9	6/3
Westinghouse Brake	£1	94/-	−2/6	16	18	3 16 6	110/-	82/-
West, Allen	5/-	13/3	−3d	17½	15°	5 13 3	16/6	8/-
Wolf Electric	5/-	20/-		17½	20	5 0 0	21/-	16/1
Trusts, Transport and Communications								
Anglo-Am. Tel.:								
A. Ord.	100	67½		6	6	8 17 6	88	67½
Ord.	100	45		3¾	3¾	8 6 8	54½	45
Anglo-Portuguese	£1	24/-	+1/-	8	8	6 13 4	27/-	21/-
Brit. Elec. Traction:								
Def. Ord.	5/-	20/-		50	22½°	5 12 6	24/3	19/6
Cable & Wireless:								
Ord.	£1	45/-x.d.	−1/6	9	10	4 9 0	54/-	39/6
4% Loan	100	92½		4	4	4 6 6	100/-	92
Calcutta Trams	£1	26/-		6†	7½†	5 15 6†	26/-	20/-
Cape Elec. Trams	£1	19/-x.d.		5½	7½	7 18 0	19/6	16/6
Marconi Marine	£1	35/-	−1/3	10	10	5 14 3	41/3	33/-
Oriental Tel. Ord.	1/-	73/9		16	—	—	102/6	72/6
Telephone Rentals	5/-	11/6	−3d	10	12½	5 8 9	13/6	9/6

Electronics

Like those credited with atomic power associations, shares connected intimately with electronics have enjoyed rising popularity during the course of this year, the investment imagination being caught by the possibilities opened up by new discoveries and their applications to business and industry. Share prices suffered heavily in the recent reaction, but with the aid of good reports about the demand for radio and T.V. equipment, some of the leading shares have gained usefully in value:—

Ord. Share	Price Jan.	Price Now	Change
Cole, E. K.	20/-	22/9	+ 2/9
Cossor, A. C.	9/6	10/9	+ 1/3
Decca	38/-	41/3	+ 3/3
Elliott Bros.	34/6	38/6	+ 4/-
E.M.I.	26/6	26/6	—
Ever Ready	23/6	31/3	+ 7/9
Plessey	66/3	75/-	+ 8/9
Pye	35/6	41/3	+ 5/9
Thorn	14/9	23/6	+ 8/9

Cables and Telephones

Financial results published this year by the cable manufacturers as a whole were less striking than those from some other branches of the electrical industries, the result being a certain amount of irregularity among the shares concerned:—

Ord. Share	Price Jan.	Price Now	Change
Aberdare	13/9	12/3	− 1/6
Automatic Tel.	70/9	65/-	− 5/9
B.I.C.C.	48/6	45/-	− 3/6
Dictograph	7/3	7/6	+ 3d
Ericsson	32/9	40/6	+ 7/9
Henley's	18/-	16/6	− 1/6
L.E.W.	51/-	51/3	+ 3d
Telephone Mfg.	9/6	10/6	+ 1/-

Miscellaneous

This year's big rise in Babcock & Wilcox shares represents, in large part, another reflection of investment interest in the future of nuclear power. In the following table are examples also of the trend in shares associated with, among other products, batteries, car and aircraft accessories and domestic equipment:—

Ord. Share	Price Jan.	Price Now	Change
Babcock & Wilcox	69/-	83/9	+ 14/9
B.E.T.	20/6	20/-	− 6d
Cable & Wireless	41/3	45/-	+ 3/9
Chloride El.	66/-	67/6	+ 1/6
Hoover	45/3	42/-	− 3/3
I.C.I.	41/9	51/3	+ 9/6
Lucas	44/6	46/3	+ 1/9
Morphy-Richards	26/6	30/-	+ 3/6
Parnall (Yate)	10/6	9/-	− 1/6
Smith, S.	17/6	16/6	− 1/-
Tube Inv.	81/3	92/6	+ 11/3

REPORTS and DIVIDENDS

Metal Industries, Ltd.—In the course of his address at the annual meeting on 6th September Mr. J. S. Hutchison, the chairman, said that an improvement last year in the profits of the Metals Division was offset by reduced earnings of the Electrical Division and in the Mechanical Engineering Division results were affected by costs of development of new products and by provisions for the termination of certain unsatisfactory contracts. The board had in progress constructive programmes of general expansion of the Electrical Division, for re-equipment and the launching of new products in the Mechanical Engineering Division, and for further developments in the Metals Division, involving new buildings and plant on a considerable scale.

In the Electrical Division the motor control and switchgear business of all the companies was affected by a cumulative and considerable increase in manufacturing costs. Prices were not adjusted until after the end of the financial year, with the result that profit margins were substantially reduced. In the second part of the year there was an unanticipated increase in demand and plans for expanding works capacity had to be pushed forward to meet it. The difficulties were now being overcome. Although costs were still rising they were able to operate from the basis of a very full order book and continuing demand.

Referring to the Mechanical Engineering Division, Mr. Hutchison said that the main part of the business of Fawcett Preston & Co., Ltd., was the supply of metal enclosures for switchgear to the other companies of the group. It had been convenient to house at the company's factory the business of resistance manufacture acquired a few months ago from the Rheostatic Co., Ltd. The Igranic Electric Co. would handle that resistance business on behalf of the group and continue to develop resistances for traction purposes. The new business should soon pass to the earning stage. Mr. Hutchison expressed his confidence in the future of the group.

George Cohen, Sons & Co., Ltd.—A summary of the company's accounts for the year ended 31st March last appeared in our issue of 22nd July. In his statement circulated with the full accounts, Mr. C. M. Cohen (chairman and managing director) states that application is shortly to be made to the Capital Issues Committee for consent to the capitalization of £1 million of the group's reserves, involving a scrip issue of two new stock units for every three held. The total funds employed in the business at 31st March last were £6¾ million. Reference is also made to the board's intention to narrow the gap between interim and final dividends by paying an interim of 3½ per cent, as before, for the current year on the increased ordinary, or the equivalent of nearly 6 per cent on the present amount. The chairman emphasizes that the proposals do not foreshadow an increase in the total amount to be distributed.

With regard to the outlook, the chairman draws attention to the recent strikes and the big increases in expenses. In the aggregate there has been no falling off in orders, but it seems that the "credit squeeze" must be an adverse influence. Though the group remains extremely busy everywhere and all manufacturing plants will be working at high pressure for some time to come, in view of the growing burden of costs and other considerations the board has budgeted for a somewhat smaller profit this year. Meeting: 28th September.

The Kenya Power Co., Ltd., offered on Tuesday last £7½ million of 5 per cent debenture stock (1975-85) at £10½ per cent of which the Colonial Development Corporation had agreed to take up £3½ million. The company was incorporated in Kenya last year as a private company jointly by the East African Power & Lighting Co., Ltd., and the Power Securities Corporation, Ltd., and was made "public" in July. Its objects are to own and operate hydro-electric power stations in the Nairobi area and to purchase and sell electricity in bulk. It proposes to take a bulk supply from the Uganda Electricity Board. The proceeds of the issue will be used to the purchase of the Tana and Wandjii power stations (totalling 21,400 kW) and associated plant and transmission lines and to meet preliminary expenses, cost of a transmission line and substation, interest until 31st December, 1957, and working capital.

A. Reyrolle & Co., Ltd., have declared an interim dividend of 6¼ per cent on the ordinary stock, as last year.

International Combustion (Holdings), Ltd., has declared an interim dividend of 7½ per cent on the ordinary capital as increased last May by a one-for-two scrip issue. Last year's interim payment of 10 per cent was equivalent to 6¾ per cent on the present equity, but the directors state that the rate now declared is designed to bring the interim dividend more into line with the final distribution.

The Telegraph Construction & Maintenance Co., Ltd., is paying an interim dividend of 3¾ per cent, the same as last year. The 977,046 £1 ordinary shares issued in July do not rank for this payment.

The directors report that for the six months ended June production and earnings for the group showed a satisfactory increase over the corresponding period of last year. Orders on hand stand at a satisfactory level and trading prospects for the remainder of the year are favourable.

The British Oxygen Co., Ltd., has declared an interim dividend on the ordinary stock of 6 per cent for the nine months ended 30th September (against 6 per cent for the previous year). This dividend is not payable on the new issue of £3,247,079 ordinary shares made last July, but the new shares will be entitled to the full amount of the final dividend.

Enfield Cables, Ltd.—The directors are seeking sanction to an increase in their borrowing powers to an amount equal to one and a half times the company's paid-up capital and the reserves of the group (excluding tax reserve). Further finance is needed because of the rise in prices of raw materials and increased turnover. At present borrowing powers are restricted to an amount equal to the paid-up capital.

An extraordinary meeting of shareholders has been called for 27th September to consider the proposal.

The British Thermostat Co., Ltd., is maintaining its interim dividend at 7½ per cent.

Increases of Capital

Electrical Appliances Finance, Ltd.—Increased by £900, in £1 ordinary shares, beyond the registered capital of £100.

Edison Swan Electric Co., Ltd.—Increased by £500,000, in £1 ordinary shares, beyond the registered capital of £1,250,000.

Receivers Released

Walker & Co. (Bournemouth), Ltd.—D. G. Gordon, F.C.A., of Midland Assurance Buildings, Fir Vale Road, Bournemouth, ceased to act as receiver and/or manager on 27th August.

Wentworth Electrical Services, Ltd.—L. Parker, of 1, Old Burlington Street, W.1, ceased to act as receiver and/or manager on 9th August.

Liquidation

Unilectric, Ltd., electrical equipment merchants, 4, Tamworth Street, Manchester, 15.—Winding up voluntarily. Liquidator, Mr. W. A. Walton, 13, Lever Street, Piccadilly, Manchester, 1, appointed 1st September.

Bankruptcies

H. Brown, lately carrying on business at 109a, Park Street, Luton, radio and electrical engineer.—First and final dividend of 1¾d in the £ payable 13th September at the Official Receiver's office, 6, The Parade, Northampton.

G. D. Fly, lately carrying on business at 111, Church Road, Willesden, N.W.10, as a radio and television dealer.—Receiving order made 30th August on debtor's petition. First meeting held 14th September. Public examination 10th November at Bankruptcy Buildings, Carey Street, London, W.C.2.

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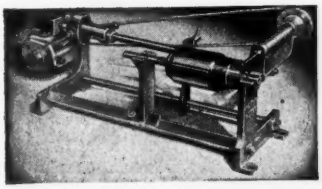
AERO-AUTO



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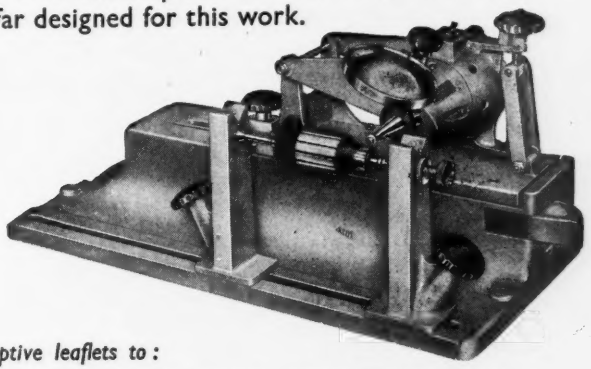

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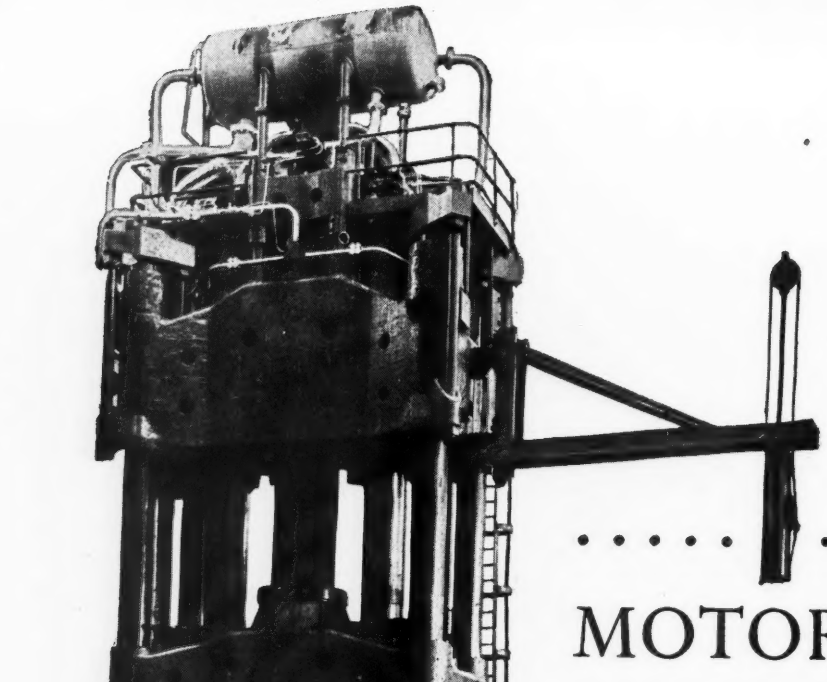
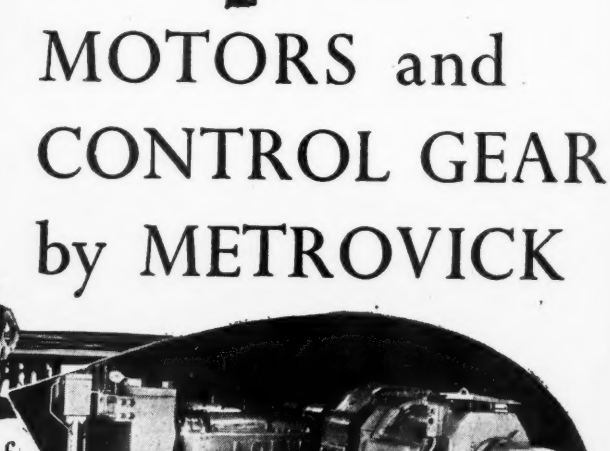


. . . .with

MOTORS and CONTROL GEAR by METROVICK



For maximum reliability and ease of maintenance, leading plant and machinery manufacturers choose motors and control gear by Metrovick. This 2,700 ton Loewy hydraulic press, for example, is powered from an air hydraulic accumulator station with five pumps each driven by a Metrovick 550 hp type RW slipring motor. The type R series of squirrel cage and slipring motors extends from 35 to 3,000 hp. Various types of enclosures are available including screen protected, drip-proof, totally enclosed with pipe ventilation, or totally enclosed with fan cooling. Write for descriptive literature dealing with your particular interest.

One of five 550 hp 730 rpm screen protected 3·3kV type RW slipring motors with type LF liquid rotor starter driving a Loewy high pressure hydraulic pump for use with hydraulic presses at Hadfields East Hecla Works, Sheffield.

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J/A 331

GENERATION AND DEVELOPMENT

Blackpool Illuminations

The Blackpool illuminations season was inaugurated on 9th September by Mr. Jacob Malik, the Soviet Ambassador. The six miles of promenade carry half a million coloured lamps which provide a setting for about 100 tableaux. One of these is 650ft long and depicts English village scenes with animated and mechanical figures. "London River Pageant," 100ft long, 20ft high and 25ft deep, is a three-dimensional creation showing Old London Bridge against a background of warehouses and the Tower of London. This year's illuminations scheme has cost nearly £80,000. More than 75 miles of wiring and cable has been used in the tableaux.

Electricity and Food Production

Following a discussion on rural electrification, the East Midlands Electricity Consultative Council at a meeting at Nottingham last week unanimously passed a resolution in which it "noted with regret" that the Chancellor of the Exchequer's statement in the House of Commons last July on action to be taken to reduce the present inflationary pressure on the country's economy contained no reference to the important contribution which a greater degree of rural electrification could make towards increasing home food production, so reducing the amount spent on imported foodstuffs. It believed that the required increase in home food production would depend, in large measure, on the greater use of electrically powered equipment on the farm which would promote increased efficiency and enable the available agricultural manpower to be used to the best advantage. The Council also pointed out that there was an urgent need for electricity to be made available to more farm cottages as well as farms in order to arrest the present trend for farm workers to leave the land owing to lack of amenities in their homes. Having regard to the economic benefits which would accrue to the country as a whole as a result of the extension of electricity supplies to the countryside, the Council suggested that the present rate of rural connections should be accelerated in the national interest.

In addition to the reports on progress and development of supplies for the months of May and June, when 6,564 consumers (including 236 farms) were connected, the Council was informed of 124 schemes approved by the Area Board for reinforcing or extending the mains. These schemes cover the provision of supplies to 3,405 new houses and 408 farms and other rural premises, the total amount of capital expenditure involved being approximately £642,300.

Supergrid Transformer

The first of two 120 MVA three-phase Metropolitan-Vickers auto-transformers for the Castle Donington transforming station of the British supergrid is shown in the accompanying photograph leaving the Trafford Park works. These units will be used to link the 132 kV and 275 kV networks of the Central Electricity Authority. Each will have three single-phase on-load tap changers on the 132 kV side to give a voltage variation of ±15 per cent in eighteen steps.

120,000 kVA auto-transformer leaving Trafford Park for the Castle Donington transforming station

South Western Tariff Changes

At a meeting of the South Western Electricity Consultative Council at Exeter last week Mr. S. F. Steward, chairman of the Board, announced increases in electricity tariffs to take effect as from the first meter readings after 25th September.

Mr. Steward pointed out that the progressive improvement in output and working efficiency had enabled the Board to "carry" earlier increases in coal costs without passing them on to consumers, but the severity of the latest rise in the price of coal and the higher costs of transport, wages and materials, now made an increase in electricity tariffs inevitable. With coal becoming scarcer and more costly, he said, it was all the more important that the electricity supply industry should go forward with its great capital programme, including the plans for nuclear power and the strengthening of main transmission and distribution networks. Under present economic conditions, the Chancellor of the Exchequer had made it clear that the industry must finance more of its rapidly growing capital requirements out of internal resources and higher revenues.

The proposed increases (excluding tariffs subject to a coal price adjustment clause) would average 10 per cent. By retaining the 1d. running rate they were ensuring that electricity would remain the cheapest form of fuel and power for all those who made a reasonable use of the supply.

The Board had also re-examined the present contributions made by the various classes of consumers to the fixed costs of supply, and it had been decided that, in the interests of equity, farmers and consumers in the smaller houses must pay a fairer share of their fixed costs. This was reflected in minor modifications to the assessment in the farm and domestic tariffs. The Board would continue to offer specially

One of the new attractions of this year's illuminations at Blackpool is a three-dimensional "London River Pageant" tableau

advantageous rates for supplies taken during off-peak periods and, in addition, to encourage the use of electricity for catering purposes. An attractive flat rate of 1¼d/kWh for cooking and water heating on commercial premises was being introduced.

The proposed revisions are as follows:—Block Tariffs. — Price per kWh in the first block raised from 5½d to 6d and in the second block from 2d to 2½d, the rate thereafter remaining at 1d. In the case of houses of one to four assessed rooms, the number of kWh in each of the first and second blocks will be increased from 40 to 50. Farm Tariff.—The number of kWh in the first block of the farm charge will be increased by 30 and in the second block by 60. The price per kWh will be the same as in the domestic and other block tariffs. Flat Rate Tariff and Contract Rates.—These will be increased from 5½d to 6d/kWh and from 2d to 2½d/kWh to bring the rates into line with the block tariffs. There will be a similar adjustment in the contract rate for "day and night" charges. The unit price for a supply of less than 20 kW, taken under the contract rate for supplies during restricted hours only, will be increased by 0·05d.

Yorkshire Tariff Revision

The Yorkshire Electricity Board's proposals for recovering the increase in costs resulting from the higher price of coal were reported to the Consultative Council last week. Because all the standard tariffs have not been operating for a full financial year, and also because the whole question of national electricity organization is under review (by the Herbert Committee), it is thought that it would be undesirable to reconstruct the Board's existing tariffs. It is not, therefore, proposed to make any change in the structure but to increase the fixed cost component of the block tariffs from 4⅛d to 4½d/kWh and to advance all rates (including the 4½d block) of all tariffs and agreements except those subject to a coal clause adjustment by 7½ per cent (this is approximately the increase in the average price paid under coal clause tariffs). The charges are to be reviewed in about twelve months' time.

As from the first meter reading after 30th September the Board is also introducing standard farm tariffs. For farm premises having an estimated maximum demand not exceeding 50 kVA there is a four-block sliding scale (F.1), the farmhouse being supplied at the standard domestic tariff (D.1)—a three-block sliding scale. Under the farm tariff the charges (subject to the 7½ per cent increase) are: For each of the first 50 kWh per quarter per kVA of assessed demand, 4½d; for each of the next 100 kWh, 1¼d; for each of the next 400 kWh, ⅝d; and thereafter at ¼d. Where the consumer does not wish to separate the wiring of the farm premises from the farmhouse there is a combined tariff (F.2).

Where the estimated demand of the farm premises is not less than 5 kVA nor more than 50 kVA and the premises are separately wired from the farmhouse, the supply to the farmhouse will be charged on Tariff D.1 and the supply to the farm, at the consumer's option, on the industrial two-part tariff (I.2).

Supplies to premises in which grass drying and grain drying apparatus, etc., is installed on a co-operative basis or by individuals or firms for the treatment of crops and products of a number of farms or similar premises will be subject to special terms if the standard tariff is not appropriate.

South of Scotland Topics

Among matters reported to the South of Scotland Electricity Consultative Council at its meeting in Glasgow on 5th September, under the chairmanship of Bailie J. Sullivan, was the opening of new service centres at George Street, Edinburgh, Arthur Street, Ayr, and Gateside Street, Largs, making the total number of centres operated by the Board seventy-seven. The Council welcomed the provision of a hire scheme for electric cookers, available to all consumers, under which the charges range from 12s 6d to 17s 6d a quarter.

Following the recent increases in the price of coal and higher labour and material costs, the Board referred to the Council for their observations certain proposals for the revision of tariffs. With the amalgamation of the former S.E. and S.W. Scotland Boards, involving the standardization of tariffs, it was necessary to consider the various price and other differentials that at present existed. The proposals were fully discussed and the Council's views conveyed to the Board.

It was reported that a consumer who occupied only part of domestic premises which were not separately wired had been charged under the commercial tariff. The Council considered that the supply was of a domestic nature and should be charged accordingly. A complaint regarding low voltage was investigated; it was noted that certain major reinforcement schemes were in hand and when these were completed the low voltage condition would be rectified. The Council also welcomed a statement on measures for the reinforcement of supply in Renfrewshire and Ayrshire. Having discussed what constituted an assessable or chargeable room under the domestic tariff, the Council agreed that the aim of the Board must be to reflect in the tariff the potential demand made by the consumer on the distribution system. The number of rooms afforded a reasonable basis.

Kepier Site to be Sold

The Central Electricity Authority has informed Durham County Council and other local authorities that the site at Kepier, Durham City, which was bought some years ago for the erection of a power station, is to be sold. Eleven years ago, when the power station scheme was first announced, considerable opposition was aroused, and following a public inquiry the scheme was rejected. Opponents of the plan contended that the landscape view of Durham City would be spoilt.

NEXT WEEK'S EVENTS

Organizers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged

Monday, 19th September, to Friday, 23rd September

LONDON. — Church House, Westminster. Tenth Congress of l'Union Internationale des Producteurs et Distributeurs d'Energie Electrique ("Unipede").

Monday, 19th September

GLASGOW.—39, Elmbank Crescent, 7.30 p.m. Institution of Works Managers, Glasgow Branch. Annual general meeting, followed by film.

IPSWICH. — Electric House, 7.15 p.m. Ipswich & District Electrical Association. Chairman's address, by S. Hardy.

Tuesday, 20th September

COVENTRY. — Coventry Electric Club. "Underwater Television," by D. R. Coleman.

LIVERPOOL.—Adelphi Hotel, 6.30 p.m. Institution of Works Managers, Merseyside Branch. Annual general meeting, followed by buffet supper.

PORTSMOUTH.—"Air Balloon," 598, Commercial Road, Mile End, 8 p.m. A.S.E.E. Portsmouth Branch. "The Preparation of Electrical Specifications," by H. J. Meader.

WOLVERHAMPTON.—Molineux Hotel, North Street, 7.30 p.m. Institution of Works Managers, Wolverhampton Branch. Annual dinner.

Wednesday, 21st September

BRISTOL.—Grand Hotel, 7.15 p.m. Incorporated Plant Engineers, Western Branch. "Coal and Oil."

Thursday, 22nd September

CANTERBURY.—County Hotel, 8 p.m. A.S.E.E. Kent Branch. "Space Heating," by E. M. Ackery.

LONDON. — Caxton Hall, S.W.1, 6 p.m. Engineers' Guild, Metropolitan Branch. Annual general meeting.

WATFORD. — A.S.E.E. Watford Branch. Evening visit to an industrial factory.

Friday, 23rd September

BATH.—S.W.E.B., Old Bridge Street, 7 p.m. I.E.S. Bath & Bristol Centre. "Interior Decoration and its Effect upon Illumination," by J. D. Layton.

BIRMINGHAM.—Regent House, St. Philip's Place, Colmore Row, 6 p.m. I.E.S. Birmingham Centre. Chairman's address, by G. E. Hanson.

CHELTENHAM.—Belle Vue Hotel. I.E.S. Gloucester & Cheltenham Centre. Annual dinner.

Saturday, 24th September

BIRMINGHAM. — A. S. E. E. Birmingham Branch. Visit to B.B.C. Television Station, Sutton Coldfield, at 3 p.m.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 19th October from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1949

18551. Minister of Supply.—Radio direction finding apparatus. 13th July, 1950. (738890.)

1950

25312. Telephone Manufacturing Co., Ltd.—Mounting arrangements for electrical apparatus. 16th October, 1951. (738642.) 25313. Rack and hand mounting arrangements for electrical apparatus employing plug and socket couplings. 16th October, 1951. Cognate application 24085/51, 17th October, 1950. Divided out of 738644. (738643.) 25314/5. Mounting arrangements for electrical apparatus. 16th October, 1951. (738644/5.)

30646. Western Electric Co., Inc.—Gaseous electric discharge apparatus. 15th December, 1950. (738732.)

1951

18616. Thorn Electrical Industries, Ltd.—Circuits for operating electric discharge lamps. 7th August, 1952. (738569.)

21694. Electric & Musical Industries, Ltd.—Number registers suitable for use in binary computing devices. 1st September, 1952. (738738). 21695. Electronic binary registers. 1st September, 1952. (738739.)

22594. Fries, G., and Vredenburg-Inglesby, J. C.—Apparatus for rendering visible magnetic and electric field patterns. 27th September, 1951. (738570.)

26181. Svenska Aktiebolaget Gasaccumulator.—Radio direction finders. 8th November, 1951. (738812.)

27827. British Telecommunications Research, Ltd.—Modulators for electric oscillations. 20th November, 1952. (738572.)

28316. Thorn Electrical Industries, Ltd.—Circuits for operating electric-discharge lamps. 7th August, 1952. Cognate application 2339, 28th January, 1952. Divided out of 738569. (738573.)

30008. Standard Telephones & Cables, Ltd.—Printed circuits. 12th December, 1952. Addition to 718811. (738575.)

1952

6727. English Electric Valve Co., Ltd.—Television pick-up cathode-ray tubes. 3rd November, 1952. (738747.)

15901. Hoover, Ltd.—Commutators. 16th June, 1953. (738823.)

19851. Minister of Supply.—Synchronizing arrangements for pulse communication systems. 13th August, 1953. (738587.)

20441. Gaudillere, P.—Radio beacon systems for position determination. 14th August, 1952. (738756.)

21688. South Wales Switchgear, Ltd., and Buttrey, R. N.—Oil immersed electric circuit-breakers. 9th July, 1953. (738657.)

23298. Electric & Musical Industries, Ltd.—Electric circuit arrangements for repeating the output of a selection of a plurality of source circuits. 12th August, 1953. (738827.)

24323. Frank, E. J.—Electric socket contacts. 29th September, 1953. (738829.)

25045. United Kingdom Atomic Energy Authority. — Electromagnetic interaction pumps suitable for liquid metal. 6th January, 1954. Cognate application 8457, 26th March, 1953. (738764.)

26527. General Electric Co.—Woven glass electrical insulating sheets. 22nd October, 1952. (738835.)

27306. British Thomson-Houston Co., Ltd.—Excitation control systems of electric generators. 5th October, 1953. (738662.)

28141. Jackson Electric Stove Co., Ltd.—Domestic electric cookers. 15th October, 1953. (738767.)

28646. British Thomson-Houston Co., Ltd.—Control circuits for electric generators operating in series. 1st October, 1953. (738663.)

29873. Telefon Fabrik Automatic Aktieselskab.—Arrangement for use in the metering and recording of telephone calls. 25th November, 1952. (738897.)

31602. Levy-Lebar, M.—Electric system governed by the movements of a movable member. 12th December, 1952. (738596.)

32102 & 32624. British Thomson-Houston Co., Ltd.—Electric lamps. 18th and 23rd December, 1952. (738666 & 738669.)

1953

1239. Philips Electrical Industries, Ltd.—Circuits for regulating the output of high-frequency oscillation generators. 15th January, 1953. (738777.)

1361. General Electric Co., Ltd., and Dale, S. H.—Servo or follow-up mechanisms. 18th January, 1954. (738670.)

1779. Metropolitan-Vickers Electrical Co., Ltd.—Electrical impedance relays. 20th January, 1954. (738844.)

1931. Wolsey Television, Ltd.—Television aerial fittings. 7th January, 1954. (738599.)

3259. British Tabulating Machine Co., Ltd.—Electronic adding circuits. 14th October, 1953. (738605.)

3662. Electric & Musical Industries, Ltd.—Manufacture of photo-electric sensitive or secondary electron emissive surfaces. 22nd January, 1954. Addition to 691795. (738850.)

3688. English Electric Co., Ltd.—Electrical converting circuits employing discharge tubes. 5th February, 1954. (738851.)

3983. Svenska Aktiebolaget Gasaccumulator.—Frequency selective electrodynamic detector. 12th February, 1953. (738852.)

4167. General Electric Co., Ltd., and Lambert, R. A.—Radiographic apparatus. 15th February, 1954. (738778.)

4390. Thorn Electrical Industries, Ltd.—Electric discharge lamp circuits. 17th February, 1954. (738856.)

5523. Allis-Chalmers Manufacturing Co.—Electric circuit interrupter. 27th February, 1953. (738674.)

6249. Adler, A. E.—Selector apparatus for automatic telephone systems. 4th March, 1954. (738608.)

6927. Ericsson Telephones, Ltd., and Sinclair, W.—Contact springsets in electrical switching apparatus. 13th March, 1953. (738677.)

7355. Compagnie Générale de Télégraphie sans Fil.—Devices for coupling and matching between a wave guide and a delay line having a periodic structure, employed in a travelling wave tube. 17th March, 1953. (738858.)

8316. British Broadcasting Corporation.—Ribbon microphones. 27th May, 1954. (738864.)

8586. General Electric Co., Ltd., Adams, O., and Hawkins, F. S.—Electric melting of glass. 15th March, 1954. (738681.)

11561. British Thomson-Houston Co., Ltd.—Electric incandescent lamps. 23rd April, 1954. (738685.)

11883. Soc. Steafix & Cie.—Process of coating electrical components. 29th April, 1953. (738788.)

12921. Radio Corporation of America.—Method of soldering an assembly of electrical conductors. 8th May, 1953. (738874.)

14018. Western Electric Co., Inc.—Electromagnetic wave signal transmission systems. 19th May, 1953. (738877.) 14472. Gaseous electric discharge devices and circuits including such devices. 15th December, 1950. Divided out of 738732. (738792.)

14482. Siemens Electric Lamps & Supplies, Ltd., and Jones, R. D.—Electrical excess voltage protective devices. 21st May, 1954. Addition to 648997. (738793.)

15537. Channel Conduits, Ltd., and Fisher, H. W. W.—Trunking or casings for electrical installations. 2nd June, 1954. (738884.)

16404. General Electric Co.—Saturable reactors. 5th June, 1953. (738886.)

17054. General Electric Co., Ltd., Major, D. C., and Power, E. B.—Apparatus for producing a spray of a liquid or a finely divided solid material. 21st June, 1954. (738619.)

17682. Compagnie Electro-Mecanique.—Method of fitting closing channels in stator slots of electrical machines. 25th June, 1953. (738620.)

19361. British Thomson-Houston Co., Ltd.—Electric motor control systems. 28th June, 1954. (738705.)

19385. Metropolitan-Vickers Electrical Co., Ltd.—Dynamo-electric machines. 16th June, 1954. (738803.)

19778. Radio Corporation of America.—Magnetic switching system. 16th July, 1953. (738706.)

20381. Metropolitan-Vickers Electrical Co., Ltd.—Dynamo-electric machines. 23rd June, 1954. (738621.) 20382. Polarity indicators for magnets. 10th June, 1954. (738910.)

22197. Westinghouse Electric International Co.—Control of parallel connected a.c. generators. 12th August, 1953. (738710.)

23398. Ericsson Telephones, Ltd., and Sinclair, W.—Telephone instruments. 25th August, 1953. (738714.)

24544. Standard Telephones & Cables, Ltd.—Television synchronizing system. 4th September, 1953. (738922.)

25112. Nederlandse Centrale Organisatie Voor Toegepast-Natuur-Wetenschappeliuk Onderzoek.—Electric circuits for the static balancing of bridge circuits provided with non-linear elements. 10th September, 1953. (738923.)

25815. Standard Telephones & Cables, Ltd.—Tunable magnetron. 18th September, 1953. (738926.)

29947. General Electric Co.—Piezo-electric devices. 29th October, 1953. (738939.)

30997. Sadir-Carpentier.—Radio navigation aiding system for aircraft. 9th November, 1953. (738945.)

31267. Philips Electrical Industries, Ltd.—Contact members for disc-shaped electrode connections. 11th November, 1953. (738948.)

31309. Hoover, Ltd.—Suction cleaners. 11th November, 1953. (738949.)

36237. British Thomson-Houston Co., Ltd.—Electroluminescent materials. 30th December, 1953. (738969.)

36238. General Electric Co.—Methods of making vacuum insulated cabinets. 30th December, 1953. (738970.)

36324. Wingfoot Corporation.—Electrical pressure cell transducer. 31st December, 1953. (738729.)

1954

1962. Western Electric Co., Inc.—Gaseous electric-discharge devices and circuits including such devices. 15th December, 1950. Divided out of 738732. (738810.)

22355. Fries, G., and Vredenburg-Inglesby, J. C.—Recording of images in the form of magnetic field patterns. 27th September, 1951. Divided out of 738570. (738634.)

29661. Allis-Chalmers Manufacturing Co.—Electric circuit interrupter. 27th February, 1953. Divided out of 738674. (738730.)

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Alva.—28th September. Burgh Council. Sodium street lighting. (See this issue.)

Australia.—25th October. Director, Posts and Telegraphs, Melbourne. Hand ringing generators. (E.S.B. 18054/55. Ten/15330.)*

Belfast.—27th October. Electricity Department. Condensate chemical treatment plant for turbo-alternators. (See this issue.)

Brazil.—6th December. Turma de Communicacoes e Arquiros, Comisao Estadual de Energia Eletrica, Edificio Novo da Prefeitura, Porto Alegre. Transmission lines. (E.S.B. 17951/55. Ten/15312.)*

Cambridge.—City Council. Street lighting equipment. (See this issue.)

Dublin.—30th September. Apron floodlighting installation at Dublin Airport. D. P. Shanagher, secretary, Department of Industry and Commerce, Kildare Street.

27th September. Eire Commissioners of Public Works. Electrical installation at Belmullett Meteorological Station, Co. Mayo. J. Tyrrell, secretary, Office of Public Works.

Durham.—County Council. Installation of electricity in family group homes at Middlestone Moor, Hartlepool, Chester-le-Street, Lanchester, Middleton-St.-George and Whickham. County architect, Court Lane.

Edinburgh.—North of Scotland Hydro-Electric Board. Electric lighting and heating installation at Sron Mor power station. Supply and erection of 33 kV and 11 kV overhead lines, etc., Deeside. (See this issue.)

Egypt.—12th November. Ministry of Public Works, Cairo. Three electric irrigation pumping stations. (E.S.B. 18724/55. Ten/15416.)*

Iraq.—15th October. Development Board, Ministry of Development, Baghdad. Air conditioning installation for Houses of Parliament. (E.S.B. 18017/55. Ten/15295.)*

Jordan.—27th September. Central Electric Corporation, Ministry of Economy, Amman. 500 kW diesel electric generating set and transformers. (E.S.B. 18855/55. Ten/15446.)*

Leitrim.—20th September. County Council. Installation and wiring of Mohill and Ballinamore dispensaries. Secretary, County Council, Courthouse, Carrick-on-Shannon.

Manchester.—5th October. Waterworks Committee. Mineral insulated cable. (See this issue.)

New Zealand.—7th October. Director-General (Stores Division), General Post Office, Wellington. Transformer stampings. (E.S.B. 18555/55. Ten/15402.)* 11th October. Secondary lead acid cells. (E.S.B. 18553/55. Ten/15371.)* 15th October. Insulation testers. (E.S.B. 18554/55. Ten/15367.)*

Old Fletton.—10th October. U.D.C. Street lighting equipment. (See this issue.)

Portuguese East Africa.—12th December. Ports, Railways and Transport Department, Lourenço Marques. Telegraphic and telephonic communications system for the Limpopo railway. (E.S.B. 18730/55. Ten/15442.)*

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

Rhodesia and Nyasaland.—22nd September. Federal Public Works Department. Electric water heaters. (E.S.B. 18928/55. Ten/15477.)*

Sandown-Shanklin. — 28th September. U.D.C. Two 20-passenger geared electric lifts at Shanklin. C. MacKechnie Jarvis & Partners, consulting engineers, 34, Victoria Street, Westminster, London, S.W.1.

Sedgefield (Durham).—R.D.C. Electrical installations in 18 houses at West Cornforth, 10 bungalows at Fishburn, and 14 houses and bungalows at Bishop Mjddleham. Housing architect, Council Offices, Sedgefield.

South Africa.—28th September. Chief Stores Superintendent, South African Railways, Johannesburg. Electric cable. (E.S.B. 18608/55. Ten/15396.)*

Sunderland.—Corporation. Installation of electricity at St. Patrick's R.C. Schools. T. Donkin, borough engineer, 27, Fawcett Street.

Uruguay.—28th September. Usinas Electricas y los Telefonos del Estado, Montevideo. Telephone equipment. (E.S.B. 18388/55. Ten/15404.)*

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Accrington.—Rebuilding of Christ Church; North & Padmore, architects, Diocesan Chambers, Bangor.

Barnsley.—Flats, Union Street—Providence Street—Britannia Street area; C. R. Hollingsworth, borough surveyor, Town Hall.

Barrow-in-Furness.—Block of offices in Duke Street; London & Manchester Assurance Co., Ltd., 50, Finsbury Square, London, E.C.2.

Battle.—Houses (42), North Trade Road; R.D.C. surveyor, The Watch Oak, Battle, East Sussex.

Birkenhead.—Houses (216) and shops between Manor Drive and Moreton Road; Richard Costain & Sons (Liverpool), Ltd., Barlows Lane, Fazackerley, Liverpool.

Boldon.—Houses for U.D.C.: R. Brown and Sons, Lord Street, South Shields (32); Gordon Durham and Co., East Boldon (32); and W. D. and R. Allison and Sons, builders, Whitburn (38).

Bolton.—Rebuilding of Nos. 11/13 Market Street for E. Sugden, Ltd.; Bradshaw, Gass & Hope, architects, 19, Silverwell Street.

Bradford.—Stage 1 of new combing mill at Fairweather Green for Woolcombers, Ltd.; W. Irwin & Co., Ltd., Burley Road, Leeds.

Brighton.—Factory, Lower Bevingdean; Brighton Sheet Metal Works, Ltd., St. James's Street.

Chertsey.—Additional factory (£200,000); Amalgamated Dental Co., Ltd., Churchfield Road.

Chobham.—County secondary school in Sunningdale Road; Surrey county architect, County Hall, Kingston-on-Thames.

Darlington. — R.C. church, Welbeck Avenue; T. H. Crawford, architect, 80, Borough Road, Middlesbrough.

Durham.—Second stage of proposed technical college at Durham (£305,000); county architect, Court Lane, Durham.

Branch library, Peterlee; Cordingley and McIntyre, architects, The College, Durham.

Edinburgh.—Houses (47), Craighall Road; city architect.

Gateshead.—Houses (547), on four estates; G. F. Winters, borough engineer.

Public library, Wrekenton; borough surveyor.

Guiseley.—Block of offices and warehouse at White Cross, for Greenwoods, Ltd.; Samuel Jackson & Son, architects, Ocean Chambers, Piccadilly, Bradford.

Horsham. — Out-patients' department, Horsham Hospital; South West Metropolitan Regional Hospital Board, 76, Wimpole Street, London, W.1.

Lancaster.—Houses (42), Ridge estate; Nicholson & Wright, Ltd., Lancaster.

Little Thurrock.—County secondary girls' school (£139,500); H. Conolly, county architect, County Hall, Chelmsford.

Liverpool.—First stage of Mabel Fletcher Technical College (£233,500); and extensions to College of Building, Clarence Street (£151,500); city engineer, Municipal Buildings, Dale Street, 2.

Six-storey hostel block for Y.M.C.A.; Medcalf & Medcalf, architects, 3, Stanley Street, Liverpool.

London.—Luxury flats, Stanhope Gate and Connaught Place. Bayswater; Dansons, Ltd., builders, 3, Violet Hill, N.W.8.

Flats (30), Mount Pleasant, Holborn; borough architect.

Extensions (£180,000) at Thames Sugar Refinery, Silvertown; Gee, Walker & Slater, Ltd., builders, 100, Park Lane, W.1.

Flats and maisonnettes, Spencer Rise, St. Pancras; Crabtree & Johnson, architects, 8, Robert Adam Street, W.1.

Office block, Pall Mall; F. G. Minter, Ltd., 4, Buckingham Gate, S.W.1.

Four-storey block of dwellings at Greville Place, N.W.; St. Marylebone Housing Association & Trust, Ltd., Cochrane Street, N.W.8.

Luton.—Office block, Leicester Road; Alcock (Peroxide), Ltd., Chaul End Lane.

Newburn (Northumberland). — Church (£25,000); Stephen Easten, Ltd., builders, Westgate Road, Newcastle-on-Tyne.

Nottingham.—Hotel, flats, open-air theatre and gymnasium on separate sites, for University Authorities; G. A. Jellicoe, architect, 12, Gower Street, London, W.C.1.

Peterborough.—Houses (200), Bluebell estate, Welland Road; city architect.

Peterlee.—Houses (136), Dene House, for Peterlee Development Corporation; Lane, Fox and Co., Ltd., contractors, High Barnes Works, Sunderland.

Pewsey.—Secondary modern school; county architect, County Hall, Trowbridge.

Preston.—Disabled persons' centre at Deepdale; E. H. Stazicker, borough surveyor, Municipal Buildings.

Rawdon.—Crematorium; Charlton & Crowther, architects, 21, Bond Street, Leeds.

Richmond (Yorks).—Secondary school (600 places); North Riding county architect, County Hall, Northallerton.

Runcorn.—Store, High Street; F. W. Woolworth & Co., Ltd., Martins Bank Building, Water Street, Liverpool.

Shaftesbury.—Houses (40), Tomlins Lane, Gillingham; R.D.C. surveyor.

Southend-on-Sea.—Flats (44), and houses (209), Fairway estate; borough architect.

Stafford.—Houses (86), Highfields estate; T. H. Higson, borough surveyor, Mount Street.

Stockport.—Dwellings (300), Brinnington estate; borough surveyor.

Taunton.—Houses (74); clerk to the R.D.C., Mary Street House.

Thirsk (Yorks).—Houses (52), Norby, for R.D.C.; Needham, Thorp and White, architects, 6, High Petergate, York.

Trafford Park (Manchester).—Industrial works, offices, etc., in Trafford Park Road, for Schori Metallising Process, Ltd., metal plastic sprayers, Brent Crescent, London, N.W.10.

Wells.—Houses (33), for R.D.C.; J. R. Morgan, surveyor, Wookey Hole Road, Wells, Somerset.